2012–2013 System Operation and Remedial Action Progress

Griggs-Walnut Ground Water Plume Superfund Site

Prepared for Las Cruces Utilities
Las Cruces, New Mexico

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List of Acronyms and Abbreviations

µg/L	microgram(s) per liter
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CLC	City of Las Cruces
COC	contaminant of concern
DAC	Doña Ana County
DBS&A	Daniel B. Stephens & Associates, Inc.
EPA	U.S. Environmental Protection Agency
feet bgs	feet below ground surface
feet msl	feet above mean sea level
FS	feasibility study
gpm	gallons per minute
GWP site	Griggs and Walnut Ground Water Plume Superfund Site
hp	horsepower
JSAI	John Shomaker & Associates, Inc.
JSP	Joint Superfund Project
MCL	maximum contaminant level
mg/L	milligram(s) per liter
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	operation and maintenance
OSE	New Mexico Office of the State Engineer
OSHA	Occupational Safety and Health Administration

List of Acronyms and Abbreviations (Continued)

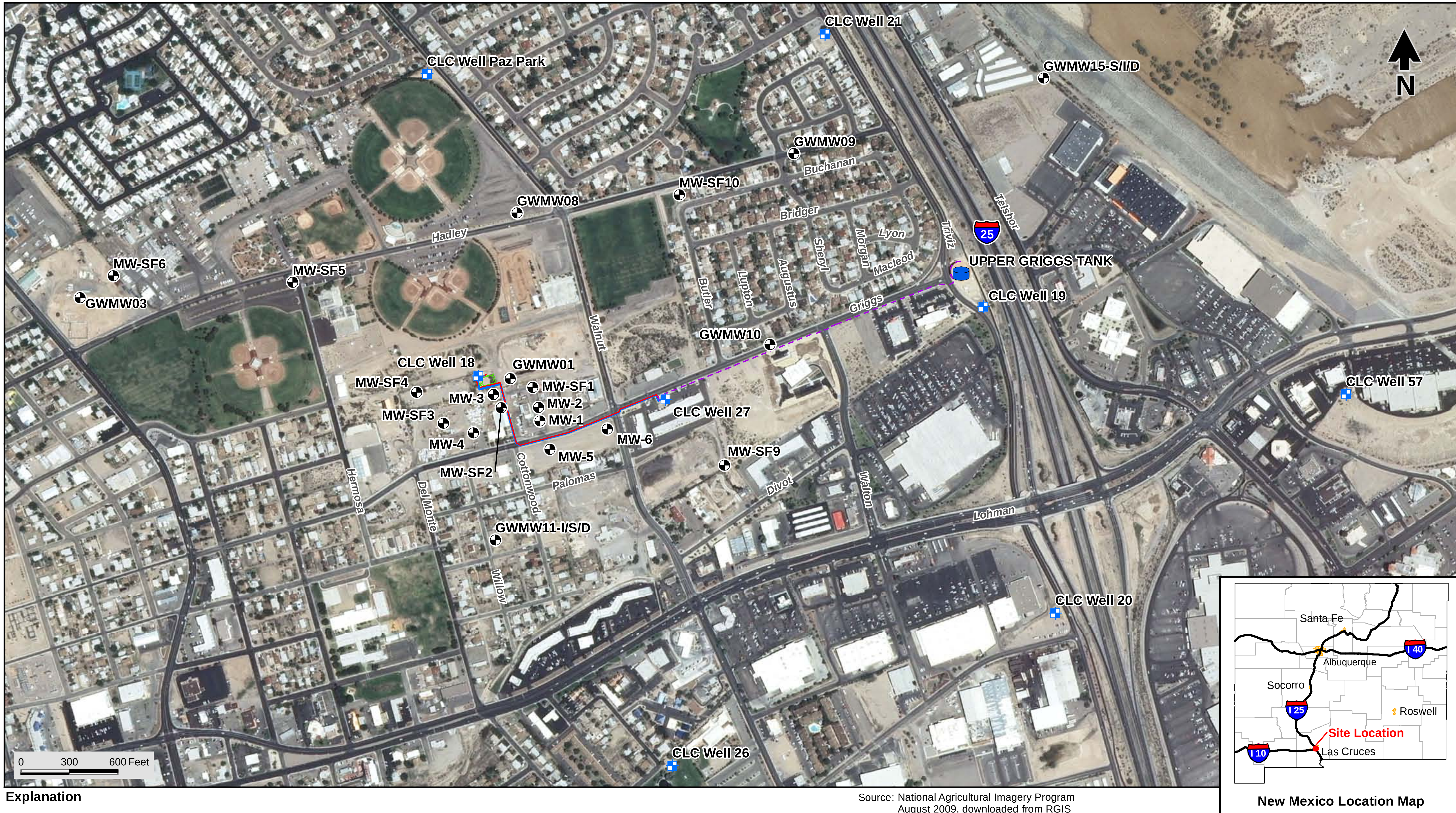
PCE	perchloroethene
RA	remedial action
RD	remedial design
RI	remedial investigation
ROD	Record of Decision
SAP	sampling and analysis plan
SCADA	supervisory control and data acquisition
scfm	standard cubic feet per minute
SOW	scope of work
TCE	trichloroethene
VOC	volatile organic compound

1. Introduction

The Joint Superfund Project (JSP), comprised of the City of Las Cruces (CLC) and Doña Ana County (DAC), has prepared this first annual report to summarize the progress made during the first year of operation of the groundwater remedy at the Griggs-Walnut Ground Water Plume Superfund Site (the GWP site) in Las Cruces, New Mexico. The JSP has prepared this annual report in accordance with Paragraph 29 of the Statement of Work included as Appendix C of the Modified Administrative Order (MAO) governing remedial action at the GWP site that was issued by the U.S. Environmental Protection Agency (EPA). The JSP has been officially operating a groundwater remediation system as designed at the GWP site since September 2012 after a three-month shake-down period starting in April 2012. The GWP site is located in south-central New Mexico in the City of Las Cruces, within Doña Ana County (Figure 1); it is impacted by contaminants of concern (COCs) in deep groundwater beneath the site, primarily dissolved-phase perchloroethene (PCE, also known as tetrachloroethene).

Prior to remedial action, the groundwater plume was located generally between East Griggs Avenue and East Hadley Avenue, extending east to beyond Interstate 25 (I-25) and west to beyond North Solano Avenue (Figure 2) in the City of Las Cruces. The property uses in this area are predominantly recreational, light industrial/commercial, and residential.

The project includes pumping contaminated groundwater from existing CLC public supply wells CLC 18 and CLC 27 to a centralized treatment facility on DAC property adjacent to CLC 18, treating the water to remove the PCE, and returning the treated groundwater into the drinking water distribution system after disinfection. The treatment facility is located immediately to the north of the old Doña Ana County Transportation Department (DACTD) maintenance facility, and immediately to the west of the new DACTD maintenance facility. The project area also extends about 1,500 feet east of the DACTD maintenance facility to the location of CLC 27. The project area is shown on Figure 1. This report details the operation of the system, data collected during system operation, progress toward performance standards, and progress toward remedial goals.



Explanation

- Monitor well
- CLC supply well
- CLC water reservoir
- Exisiting 10" water line to reservoir
- 6" raw water line
- 8" treated water line
- Treatment compound

Source: National Agricultural Imagery Program
August 2009, downloaded from RGIS

GRIGGS-WALNUT GROUND WATER PLUME SITE
REMEDIAL ACTION

Site Area with Monitor Well Locations

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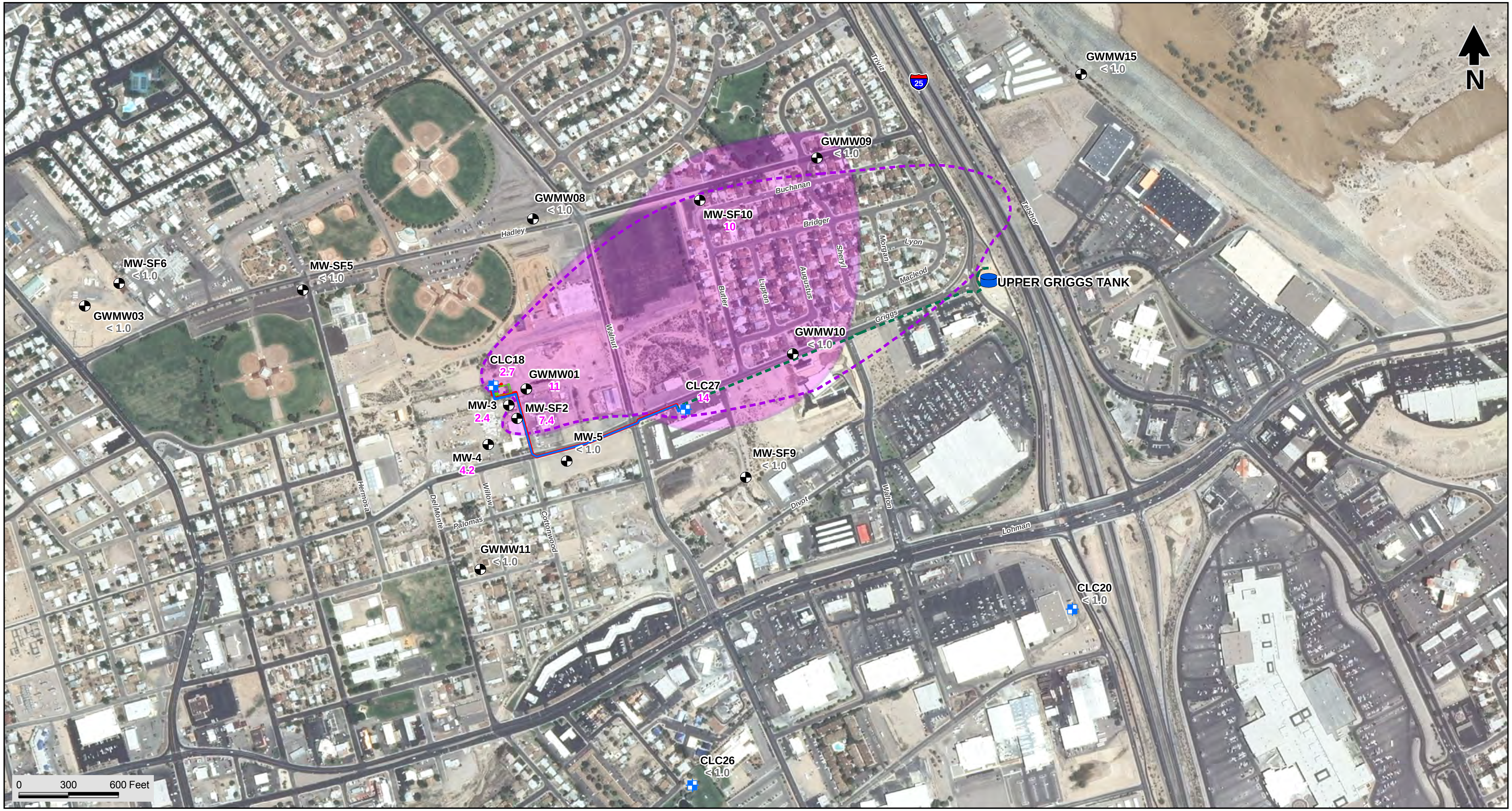
06/06/2012 JN ES09.0306

Figure 1



Explanation

- MonitorWell
- CLC supply well
- PCE in groundwater May 2013
- 2012 areal extent of PCE plume
- Exisiting 10" water line to reservoir
- 6" raw water line
- 8" finished water line
- Treatment compound

MW-4 Well designation

4.2 Concentration (µg/L)

< 1.0 Not detected above reporting limit

Source: National Agricultural Imagery Program August 2009. Downloaded from RGIS.

GRIGGS-WALNUT GROUND WATER PLUME SITE
REMEDIAL ACTION

PCE in Groundwater, 2012 and 2013

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Figure 2

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1.1 Background

Between 1993 and 1995, trace amounts of PCE, a chlorinated solvent commonly used as a degreaser and as a dry cleaning agent, was detected in five wells during routine sampling performed by NMED. Through continued testing, CLC Utilities took the wells offline—specifically CLC 18 in 1996 and CLC 27 in 2000—due to PCE levels approaching the MCL.

The GWP site was added to EPA's National Priorities List (NPL) of Superfund sites on June 14, 2001. At the time of listing, five CLC municipal drinking water supply wells (CLC 18, 19, 21, 24, and 27) were known to be affected by PCE contamination at concentrations above the maximum contaminant level (MCL) of 5 micrograms per liter (µg/L) for PCE established by the Safe Drinking Water Act (SDWA).

The remedial investigation (RI) and feasibility study (FS) were performed by CH2M Hill under contract to the EPA (CH2M Hill, 2006a and 2006b). The Proposed Plan prepared in December 2006 (U.S. EPA, 2006) and the ROD issued by EPA on June 14, 2007 (U.S. EPA, 2007) set forth the selected remedy for the GWP site, which identified groundwater pumping from existing wells and treatment at the CLC 18 site as the preferred remedy. The maximum PCE concentrations measured during sampling for the remedial design (RD) in CLC 18 and CLC 27 were 56 and 13 µg/L, respectively (Terracon, 2010).

Construction of the remedy began in September of 2011. During the next six months, tanks were constructed, the building and treatment system were installed, and wells CLC 18 and CLC 27 were reconfigured work more efficiently as extraction wells and connected to the treatment system. A pre-final inspection was conducted for Substantial Completion on April 16, 2012, and was attended by representatives of EPA, NMED, DBS&A, CLC, and Highland Enterprises. A punch list of items requiring completion was developed as a result of the pre-final inspection. All items on the punch list were relatively minor and were corrected by the Contractor to the satisfaction of the EPA, NMED, Owner, and DBS&A. On June 13, 2012, a final inspection was completed to verify that all punch list items were addressed, which was signed off on by representatives from EPA, NMED, DBS&A, CLC, and Highland Enterprises. A preliminary Close-out Report was completed and signed June 22, 2012 by EPA.

1.2 Purpose

The purpose of this report is to summarize the progress that has been made in addressing the groundwater contamination at the GWP site. Between April 2012 and August 2013, approximately 234,392,638 gallons of water containing PCE have been treated to a non-detect level, and more than 196,732,887 gallons of that treated water has been used for public water supply. Over the course of the time between the substantial completion of the treatment system and August 2013, more than 14 pounds of PCE have been removed from the groundwater. This also includes progress made toward understanding and optimizing system performance, as described in detail in the John Shomaker and Associates Inc. (JSAI) report of September 2013 (Appendix A).

2. Site Activities

Since April 2012, the groundwater extraction and treatment system has been operated with no major down-times. Operation of the selected remedy has included the following tasks:

- Sampling CLC 18 and CLC 27 monthly for PCE concentration
- Sampling system raw and finished monthly for PCE concentration
- Normal operation and maintenance of extraction system, conveyance system, and treatment equipment
- Groundwater monitoring (results discussed in Section 2.3)

2.1 Treatment System Operation

Operation of the treatment system includes monitoring the extracted (raw) and treated (finished) groundwater volatile organic compounds (VOCs) and total metals. At the same time, the volume of water being extracted and treated is also recorded. In order to ensure that air quality standards are not exceeded during the removal of VOCs via air stripping, air quality samples are also collected from the waste stream that exits the GWP site. Table 1 summarizes the analytes that are being monitored.

2.1.1 Treated Groundwater

Table 2 summarizes the sampling frequency of the remediation system sampling.

Table 3 summarizes the volume pumped from each CLC 18 and CLC 27 as reported to the New Mexico Office of the State Engineer (OSE). Table 4 summarizes the raw (wells CLC 18 and CLC 27 combined) concentration of PCE, the finished (post-treatment) concentration of PCE, the total volume of water treated, and the monthly volume of PCE removed. It should be noted that the raw volume and finished volumes will not match due to time differences between readings for the OSE and SCADA downloads, storage, and demand.

Table 1. Analytical Methodologies and Screening Levels

Analyte Class	Analytical Method	Concentration (µg/L) Method Detection Limit [a]	EPA MCL	NMQCC Standard
Air				
PCE	8260B	0.39	NA	NA
TCE	8260B	0.24	NA	NA
DCE	8260B	0.27	NA	NA
Vinyl chloride	8260B	0.4	NA	NA
Groundwater				
PCE	8260B	0.39	5	20
TCE	8260B	0.24	5	100
DCE	8260B	0.27	5	10
Vinyl chloride	8260B	0.4	2	1
Arsenic	6020, ICPMS	0.07	10	100
Arsenic speciation	SM 3114B Mod.	2	10	100
Uranium	6020, ICPMS	0.011	30	30

[a] Method detection limit does not imply reporting limit.

µg/L = Micrograms per liter
MCL = Maximum contaminant level
NMWQCC = New Mexico Water Quality Control Commission
NA = Not applicable

Table 2. Remediation System Sampling Frequency

Sample Location	Sample Matrix	Sample Point	Sample Method	Sample Analyses	Startup Sample Collection Schedule [a]	Normal Operation Sampling and Monitoring Schedule
Pump P-1 finished	Groundwater	IS1	Grab	EPA 8260B for VOCs, field temperature, pH, and conductivity	Sample after first hour of operation of pump P-1. Every other day for first 6 days of operation.	Sample once per week for weeks 2 through 8. Thereafter, sample once per month or as directed.
C-1 finished	Groundwater	C1	Grab	EPA 8260B for VOCs, field temperature, pH, and conductivity	Sample after first 2 hours of operation of pump P-1. Once per day for days 2 through 6 of system operation.	Sample once per week for weeks 2 through 8. Thereafter, sample once per month or as directed.
C-2 finished	Groundwater	C2	Grab	EPA 8260B for VOCs, field temperature, pH, and conductivity	Sample after first 2 hours of operation of pump P-1. Once per day for days 2 through 6 of system operation.	Sample once per week for weeks 2 through 8. Thereafter, sample once per month or as directed.
Finished downstream of chlorine disinfection	Groundwater	ES1	Grab	EPA 8260B for VOCs, field temperature, pH, and conductivity	Sample after first 2 hours of operation of pump P-1. Once per day for days 2 through 6 of system operation.	Sample once per week for weeks 2 through 8. Thereafter, sample once per month or as directed.
C-1 air stripper emissions	Air	AS1	Grab	EPA 8260B for VOCs	Sample once per day for the first 3 days and once per week during remaining startup.	Sample once per week for weeks 2 through 4. Thereafter, sample once per month or as directed.
C-2 air stripper emissions	Air	AS2	Grab	EPA 8260B for VOCs	Sample once per day for the first 3 days and once per week during remaining startup.	Sample once per week for weeks 2 through 4. Thereafter, sample once per month or as directed.

[a] Plant will remain offline until startup is completed and normal operation is verified. A minimum of 4 weeks shakedown and startup will be accomplished prior to bringing system online.
VOCs = Volatile organic compounds

Table 3. Volume of Water Extracted and PCE Concentrations, CLC 18 and CLC 27 April 2012 through August 2013

	CLC 18		CLC 27	
Month	Groundwater Extracted (gallons)	Raw PCE Concentration (µg/L)	Groundwater Extracted (gallons)	Raw PCE Concentration (µg/L)
Apr 2012	3,268,000	63	1,956,000	14
May 2012	7,089,000	42	3,826,000	6
Jun 2012	6,327,000	—	3,301,000	—
Jul 2012	6,662,000	—	4,037,000	—
Aug 2012	8,875,000	—	5,359,000	—
Sep 2012	8,279,000	0.0	5,217,000	0.0
Oct 2012	10,085,000	0.0	5,629,000	0.0
Nov 2012	9,980,000	0.0	4,891,000	0.0
Dec 2012	10,562,000	2.8	4,908,000	13.5
Jan 2013	10,753,000	2.5	4,937,000	14.0
Feb 2013	9,966,000	2.0	4,648,000	14.0
Mar 2013	10,502,000	2.3	5,199,000	12.0
Apr 2013	10,346,000	2.5	4,896,000	13.5
May 2013	10,700,000	2.3	5,055,000	12.0
Jun 2013	10,432,000	2.3	4,807,000	13.0
Jul 2013	6,453,000	3.1	5,879,000	11.0
Aug 2013	9,519,000	2.4	5,644,000	14.0
Total	149,798,000		80,189,000	

PCE = Perchloroethene
µg/L = Micrograms per liter

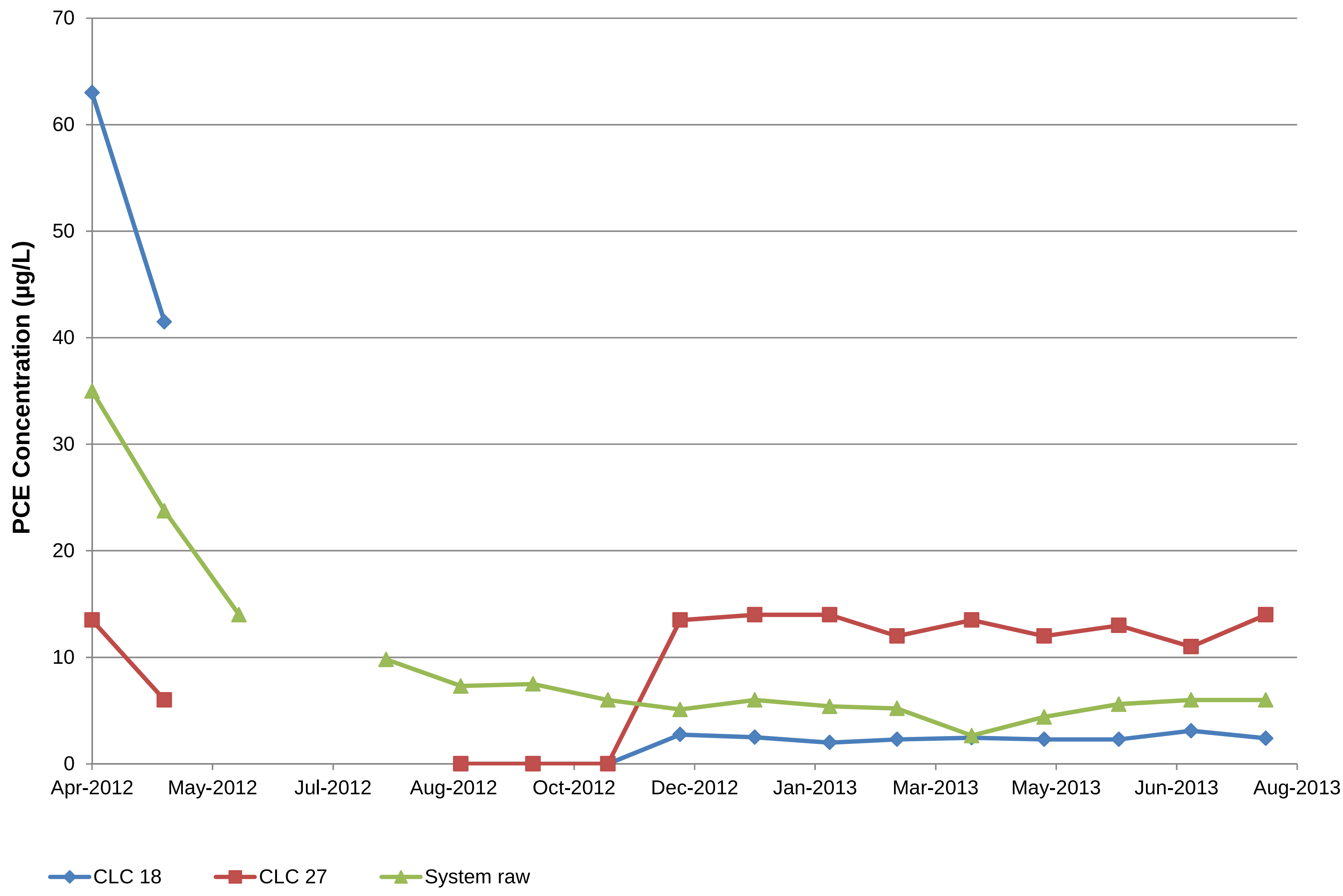
Table 4. Mass of PCE Removed from Groundwater
April 2012 through August 2013

Month	PCE Concentration (µg/L)		Volume Treated (gallons)	Mass of PCE Removed (pounds)
	Raw	Finished		
Apr 2012	35	ND	5,224,000	1.53
May 2012	23.75	ND	11,037,530	2.19
Jun 2012	14.0	—	10,556,255	1.23
Jul 2012	—	—	10,841,966	0.00
Aug 2012	9.8	ND	13,757,090	1.12
Sep 2012	7.3	ND	13,720,328	0.84
Oct 2012	7.5	ND	15,725,735	0.98
Nov 2012	6.0	ND	15,515,830	0.78
Dec 2012	5.10	ND	15,875,749	0.68
Jan 2013	6.0	ND	16,032,751	0.80
Feb 2013	5.4	ND	14,549,490	0.66
Mar 2013	5.20	ND	16,253,840	0.71
Apr 2013	2.65	ND	15,605,853	0.35
May 2013	4.4	ND	16,001,065	0.59
Jun 2013	5.6	ND	15,364,714	0.72
Jul 2013	6.0	ND	12,923,331	0.65
Aug 2013	6.0	ND	15,407,112	0.77
Total			234,392,638	14.58

PCE = Perchloroethene
µg/L = Micrograms per liter

The concentration of PCE entering the system has declined by 87 percent from the system start-up to May 2013, decreasing from 35 µg/L in April 2012 to 4.40 µg/L in May 2013 (Figure 3). The concentration of PCE in CLC 18 has fallen 96 percent from April 2012 to May 2013, while the concentration in CLC 27 has been relatively stable over the same time period. The significant decreases in PCE concentration in CLC 18 suggests that a significant volume of uncontaminated water is being captured at this location, thus diluting raw concentrations. Steps taken to evaluate system optimization are presented in Section 2.3 of this report.

The treatment system is operating as designed, and is effectively removing PCE; the finished concentration was consistently below detection limits (Table 4).



GRIGGS-WALNUT GROUND WATER PLUME SITE
REMEDIAL ACTION

PCE Concentrations Over Period of Operation

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9/26/13

Figure 3

2.1.2 Air Emissions

All of the COCs removed from the groundwater are assumed to be released to the atmosphere. Based on the raw and finished concentrations of each contaminant, potential air emissions from the air strippers were calculated. The NMED Air Quality Bureau emissions standards for a No Permit Required (NPR) designation are 10 pounds per hour (lb/hr) and 10 tons per year. The pounds per hour emission rate was calculated by dividing the calculated monthly mass of PCE removed in pounds by the number of hours in a month. The emission rate in pounds per year was calculated by summing the calculated mass of PCE removed for the calendar year. The results of these calculations are summarized in Tables 5 and 6.

Table 5. Calculated Air Emissions Based on Measured Raw and Finished Concentrations

Month	Calculated PCE Air Emissions (lb/hr)
Apr 2012	0.002
May 2012	0.003
Jun 2012	0.002
Jul 2012	0.000
Aug 2012	0.000
Sep 2012	0.001
Oct 2012	0.001
Nov 2012	0.001
Dec 2012	0.001
Jan 2013	0.001
Feb 2013	0.001
Mar 2013	0.001
Apr 2013	0.000
May 2013	0.001

lb/hr = Pounds per hour
PCE = Perchloroethene

Table 6. Calculated Air Emissions by Year Based on Measured Raw and Finished Concentrations

Contaminant of Concern	Calculated Air Emissions (tons/year)	
	2012	2013 (to date)
PCE	4.01 x 10^{-3}	1.52 x 10^{-3}

The calculated emission rate for PCE is well below limits and the NPR designation is still valid.

2.2 Groundwater Monitoring

Attainment of the remedial action objectives (RAOs) is monitored through the collection of water quality samples from existing monitor wells. Table 7 identifies the wells in which samples were proposed to be collected as detailed in the SAP included as part of the final RA Work Plan (DBS&A, 2011). The list proposed in the SAP was generated based on work done several years ago by the EPA. After the groundwater monitoring event associated with system startup in April 2012 was completed and several wells could not be found, CLC completed a well location report and attempted to locate and document the location of the monitor wells associated with this site. A complete discussion of this evaluation is included as Appendix B. Four of the wells, MW-1, MW-2, MW-6, and MWSF-1, appear to have collapsed. Two of the wells, MWSF-3 and MWSF-4, appear to have been covered in the DACTD yard but have recently been positively located and uncovered. The port tubing gas feed lines 1 and 2 of GWMW08 appear to have been damaged.

Table 8 lists the analyses performed on the groundwater samples. Tables 9 and 10 summarize results from the April 2012 and April/May 2013 sampling events detections by well, respectively. All wells listed in the SAP that could be located were sampled in both May 2012 and May 2013. Complete analytical reports for both the April 2012 and May 2013 sampling events are included as Appendix C.

Table 7. Wells Included in the Groundwater Monitoring Program

Sample Location	No. of Samples
CLC 18	1
CLC 20	1
CLC 26	1
CLC 27	1
CLC 57	1
CLC Paz Park Well	1
GWMW01	7
GWMW03	6
GWMW08 [a]	7
GWMW09	7
GWMW10	7
GWMW11-S	1
GWMW11-I	1
GWMW11-D	1
GWMW15-S	1
GWMW15-I	1

Sample Location	No. of Samples
GWMW15-D	1
MW-1	1
MW-2	1
MW-3	1
MW-4	1
MW-5	1
MW-6	1
MW-SF1	1
MW-SF2	1
MW-SF3	1
MW-SF4	1
MW-SF5	1
MW-SF6	1
MW-SF9	1
MW-SF10	1

Note: The large number of samples from GWMW01 through GWMW10 is reflective of the number of sample ports at those wells.

[a] Samples not collected from ports 1 and 2 because of air leak.

Table 8. List of Analytes Reported in 8260 Analysis of Groundwater Samples

Analyte	Units
1,1,1,2-Tetrachloroethane	µg/L
1,1,1-Trichloroethane	µg/L
1,1,2,2-Tetrachloroethane	µg/L
1,1,2-Trichloroethane	µg/L
1,1-Dichloroethane	µg/L
1,1-Dichloroethene	µg/L
1,1-Dichloropropene	µg/L
1,2,3-Trichlorobenzene	µg/L
1,2,3-Trichloropropane	µg/L
1,2,4-Trichlorobenzene	µg/L
1,2,4-Trimethylbenzene	µg/L
1,2-Dibromo-3-chloropropane	µg/L
1,2-Dibromoethane (EDB)	µg/L
1,2-Dichlorobenzene	µg/L
1,2-Dichloroethane (EDC)	µg/L
1,2-Dichloropropane	µg/L
1,3,5-Trimethylbenzene	µg/L
1,3-Dichlorobenzene	µg/L
1,3-Dichloropropane	µg/L
1,4-Dichlorobenzene	µg/L
1-Methylnaphthalene	µg/L
2,2-Dichloropropane	µg/L
2-Butanone	µg/L
2-Chlorotoluene	µg/L
2-Hexanone	µg/L
2-Methylnaphthalene	µg/L
4-Chlorotoluene	µg/L
4-Isopropyltoluene	µg/L
4-Methyl-2-pentanone	µg/L
Acetone	µg/L
Arsenic	mg/L
Benzene	µg/L
Bromobenzene	µg/L
Bromodichloromethane	µg/L
Bromoform	µg/L

Analyte	Units
Bromomethane	µg/L
Carbon disulfide	µg/L
Carbon tetrachloride	µg/L
Chlorobenzene	µg/L
Chloroethane	µg/L
Chloroform	µg/L
Chloromethane	µg/L
cis-1,2-DCE	µg/L
cis-1,3-Dichloropropene	µg/L
Dibromochloromethane	µg/L
Dibromomethane	µg/L
Dichlorodifluoromethane	µg/L
Ethylbenzene	µg/L
Hexachlorobutadiene	µg/L
Isopropylbenzene	µg/L
Methyl tert-butyl ether (MTBE)	µg/L
Methylene chloride	µg/L
Naphthalene	µg/L
n-Butylbenzene	µg/L
n-Propylbenzene	µg/L
sec-Butylbenzene	µg/L
Styrene	µg/L
tert-Butylbenzene	µg/L
Tetrachloroethene (PCE)	µg/L
Toluene	µg/L
trans-1,2-DCE	µg/L
trans-1,3-Dichloropropene	µg/L
Trichloroethene (TCE)	µg/L
Trichlorofluoromethane	µg/L
Uranium	mg/L
Vinyl chloride	µg/L
Xylenes, total	µg/L
pH	s.u.
Temperature	°C
Electrical conductivity	µmhos/cm

Table 9. Analyte Detections, April 2012
Page 1 of 2

Sample ID	Concentration [a] (µg/L)													
	1,2,4-TMB	MEK	2-Methyl Naphthalene	Acetone	Benzene	Ethylbenzene	Isopropyl-benzene	MTBE	Napthalene	n-Propyl-benzene	PCE	Toluene	TCE	Total Xylenes
CLC18 (4/16/12)	—	—	—	—	—	—	—	—	—	—	**56.0**	—	1.6	—
CLC18 (4/18/12)	—	—	—	—	—	—	—	—	—	—	**70.0**	—	1.2	—
CLC18 (5/8/12)	—	—	—	—	—	—	—	—	—	—	**42.0**	—	—	—
CLC18 (5/8/12) Dup	—	—	—	—	—	—	—	—	—	—	**41.0**	—	—	—
CLC27 (4/16/12)	—	—	—	—	—	—	—	—	—	—	**13.0**	—	—	—
CLC27-(4/18/12)	—	—	—	—	—	—	—	—	—	—	**14.0**	—	—	—
CLC27-(5/8/12)	—	—	—	—	—	—	—	—	—	—	**12.0**	—	—	—
GWMW01(01)	—	—	—	—	—	—	—	—	—	—	**5.8**	1.3	—	—
GWMW01(02)	—	—	—	—	1.3	—	—	—	—	—	—	4.9	—	—
GWMW01-03	—	—	—	—	1.7	—	—	—	—	—	2.7	4.4	1.0	—
GWMW01-04	—	—	—	—	1.7	—	—	—	—	—	—	4.9	—	—
GWMW01-05	—	—	—	—	—	—	—	—	—	—	3.2	2.8	—	—
GWMW01-06	—	—	—	—	—	—	—	—	—	—	**11.0**	2.7	—	—
GWMW01-06 Dup	—	—	—	—	—	—	—	—	—	—	**11.0**	2.9	—	—
GWMW01-07	—	—	—	—	1.0	—	—	—	—	—	3.2	3.5	—	—
GWMW03-01	—	—	—	—	—	—	—	—	—	—	—	8.0	—	—
GWMW03-02	—	—	—	—	1.8	—	—	—	—	—	—	21.0	—	—
GWMW03-03	—	—	—	—	1.2	—	—	—	—	—	—	12.0	—	—
GWMW03-05	—	—	—	—	—	—	—	—	—	—	—	5.4	—	—
GWMW03-06	—	—	—	—	2.8	—	—	—	—	—	—	19.0	—	—
GWMW08-03	—	—	—	—	—	—	—	—	—	—	—	5.1	—	—
GWMW08-04	—	—	—	—	—	—	—	—	—	—	—	5.0	—	—
GWMW08-05	—	—	—	—	—	—	—	—	—	—	—	5.3	—	—
GWMW08-06	—	—	—	—	—	—	—	—	—	—	—	5.2	—	—
GWMW08-07	—	—	—	—	**8.1**	—	—	—	—	—	—	13.0	—	—
GWMW09-01	—	—	—	—	**6.5**	—	—	—	—	—	—	84.0	—	—
GWMW09-02	—	—	—	—	**7.1**	—	—	—	—	—	1.3	89.0	—	—
GWMW09-03	—	—	—	—	**6.8**	—	—	—	—	—	—	57.0	—	—
GWMW09-04	—	—	—	—	4.6	—	—	—	—	—	1.2	26.0	—	—
GWMW09-05	—	—	—	—	4.4	—	—	—	—	—	1.7	20.0	—	—
GWMW09-06	—	—	—	—	2.3	—	—	—	—	—	—	4.3	—	—
GWMW09-07	—	—	—	—	4.7	—	—	—	—	—	—	32.0	—	—

[a] **Bold** indicates values above the maximum contaminant level (MCL).

µg/L = Micrograms per liter
TMB = Trimethylbenzene
MEK = Methyl ethyl ketone
MTBE = Methyl tertiary-butyl ether

PCE = Perchloroethene
TCE = Trichloroethene
— = Not detected above laboratory reporting limit

Table 9. Analyte Detections, April 2012
Page 2 of 2

Sample ID	Concentration [a] (µg/L)													
	1,2,4-TMB	MEK	2-Methyl Naphthalene	Acetone	Benzene	Ethylbenzene	Isopropyl-benzene	MTBE	Napthalene	n-Propyl-benzene	PCE	Toluene	TCE	Total Xylenes
GWMW10-01	—	—	—	—	—	—	—	—	—	—	**47.0**	1.2	1.1	—
GWMW10-02	—	—	—	—	1.9	—	—	—	—	—	**14.0**	7.4	1.4	—
GWMW10-03	—	—	—	—	—	—	—	—	—	—	**45.0**	4.9	1.4	—
GWMW10-04	—	—	—	—	1.2	—	—	—	—	—	4.5	11.0	—	—
GWMW10-05	—	—	—	—	—	—	—	—	—	—	—	2.3	—	—
GWMW10-06	—	—	—	—	—	—	—	—	—	—	—	10.0	—	—
GWMW10-07	—	—	—	—	1.1	—	—	—	—	—	—	11.0	—	—
GWMW15-I	—	—	—	—	—	—	—	—	—	—	2.3	—	—	—
GWMW15 Dup	—	—	—	—	—	—	—	—	—	—	2.6	—	—	—
MWSF-1	—	—	—	—							**9.6**	—	—	—
MWSF2	—	—	—	—	—	—	—	—	—	—	**11.0**	—	—	—
MWSF-10	—	—	—	—	—	—	—	—	—	—	**9.5**	—	—	—
MWSF-10 Dup	—	—	—	—	—	—	—	—	—	—	**9.6**	—	—	—
MW-1	—	—	—	—	**65.0**	750.0	—	—	—	—	—	—	—	580.0
MW-3	—	—	—	—	—	—	—	—	—	—	3.6	—	—	—
MW-4	—	—	—	—	—	—	—	—	—	—	1.1	—	—	—
MW-6-	—	—	—	—	4.8	—	—	—	—	—	2.3	—	—	—

[a] **Bold** indicates values above the maximum contaminant level (MCL).

µg/L = Micrograms per liter
TMB = Trimethylbenzene
MEK = Methyl ethyl ketone
MTBE = Methyl tertiary-butyl ether
PCE = Perchloroethene
TCE = Trichloroethene
— = Not detected above laboratory reporting limit

Table 10. Analyte Detections, May 2013
Page 1 of 2

	Concentration (µg/L)												
Sample ID	1,2,4-TMB	MEK	2-Methyl Naphthalene	Acetone	Benzene	Ethylbenzene	Isopropyl-benzene	MTBE	Napthalene	n-Propyl-benzene	PCE	Toluene	TCE
CLC-18	—	—	—	—	—	—	—	—	—	—	2.7	—	—
CLC-27	—	—	—	—	—	—	—	—	—	—	14	—	—
Paz Park	—	—	—	—	—	—	—	1.0	—	—	—	—	—
MW-1	73	—	28	—	14	230	13	13	49	36	—	—	—
MW-3	—	—	—	—	—	—	—	—	—	—	2.4	—	—
MW-4	—	—	—	—	—	—	—	—	—	—	4.2	—	—
MW-SF2	—	—	—	—	—	—	—	—	—	—	7.4	—	—
MW-SF10	—	—	—	—	—	—	—	—	—	—	10	—	—
GWMW-01(1)	—	—	—	—	—	—	—	—	—	—	11	1.4	—
GWMW-01(3)	—	—	—	—	1.0	—	—	—	—	—	3.2	4.9	—
GWMW-01(3-Dup)	—	—	—	—	1.5	—	—	—	—	—	1.5	6.2	—
GWMW-01(4)	—	—	—	—	1.2	—	—	—	—	—	—	4.5	—
GWMW-01(5)	—	—	—	—	—	—	—	—	—	—	—	3.1	—
GWMW-01(6)	—	—	—	—	—	—	—	—	—	—	14	3.1	—
GWMW-01(7)	—	—	—	—	—	—	—	—	—	—	3.6	3.6	—
GWMW-03(1)	—	18	—	19	1.5	—	—	—	—	—	—	14	—
GWMW-03 (1-Dup)	—	—	—	—	—	—	—	—	—	—	—	7.3	—
GWMW-03(2)	—	—	—	15	2.2	—	—	—	—	—	—	24	—
GWMW-03(3)	—	66	—	—	1.3	—	—	—	—	—	—	15	—
GWMW-03(4)	—	—	—	20	3.6	—	—	—	—	—	—	16	—
GWMW-03(5)	—	—	—	—	2.8	—	—	—	—	—	—	21	—
GWMW-03(6)	—	—	—	—	2.9	—	—	—	—	—	—	23	—
GWMW-08(3)	—	—	—	—	1.1	—	—	—	—	—	—	7.8	—
GWMW-08(3-Dup)	—	—	—	—	—	—	—	—	—	—	—	6.4	—
GWMW-08(4)	—	—	—	—	—	—	—	—	—	—	—	6.3	—
GWMW-08(5)	—	—	—	—	—	—	—	—	—	—	—	6.2	—
GWMW-08(6)	—	—	—	—	—	—	—	—	—	—	—	6.1	—
GWMW-08(7)	—	13	—	55	3.0	—	—	2.4	—	—	—	13	—
GWMW-09(1)	—	—	—	—	—	—	—	—	—	—	—	73	—
GWMW-09 (1-Dup)	—	—	—	—	—	—	—	—	—	—	—	83	—
GWMW-09 (2)	—	—	—	—	—	—	—	—	—	—	—	46	—
GWMW-09(3)	—	—	—	—	—	—	—	—	—	—	—	32	—

µg/L = Micrograms per liter
TMB = Trimethylbenzene
MEK = Methyl ethyl ketone
MTBE = Methyl tertiary-butyl ether
PCE = Perchloroethene
TCE = Trichloroethene
— = Not detected above laboratory reporting limit

Table 10. Analyte Detections, May 2013
Page 2 of 2

Sample ID	Concentration (µg/L)												
	1,2,4-TMB	MEK	2-Methyl Naphthalene	Acetone	Benzene	Ethylbenzene	Isopropyl-benzene	MTBE	Napthalene	n-Propyl-benzene	PCE	Toluene	TCE
GWMW-09(4)	—	—	—	34	1.9	—	—	—	—	—	—	21	—
GWMW-09(5)	—	—	—	—	—	—	—	—	—	—	—	14	—
GWMW-09(6)	—	—	—	—	—	—	—	—	—	—	—	32	—
GWMW-09(7)	—	—	—	—	—	—	—	—	—	—	—	43	—
GWMW-10(2)	—	—	—	14	1.8	—	—	—	—	—	7.1	9.6	1.5
GWMW-10(3)	—	—	—	—	—	—	—	—	—	—	42	4.6	1.3
GWMW-10(4)	—	—	—	24	1.2	—	—	—	—	—	3.7	15	—
GWMW-10(5)	—	—	—	32	1.2	—	—	—	—	—	—	16	—
GWMW-10(5-Dup)	—	—	—	—	—	—	—	—	—	—	—	11	—
GWMW-10(6)	—	—	—	—	—	—	—	—	—	—	—	12	—
GWMW-10(7)	—	—	—	—	—	—	—	—	—	—	—	3.4	—

µg/L = Micrograms per liter
TMB = Trimethylbenzene
MEK = Methyl ethyl ketone
MTBE = Methyl tertiary-butyl ether
PCE = Perchloroethene
TCE = Trichloroethene
— = Not detected above laboratory reporting limit

Trichloroethylene (TCE) was the only PCE degradation product detected in groundwater. TCE was detected in ports 2 and 3 of existing well GWMW-10 at concentrations of 1.5 and 1.3 µg/L, respectively. The remaining compounds detected were fuel hydrocarbons, with benzene and toluene detected in most of the wells sampled. Acetone was also identified in a number of multiport wells installed by CH2M Hill. Acetone has been reported in these wells previously, although a source of acetone has never been identified. These results are may be related to the construction of these wells.

Figure 2 shows the extent of the PCE plume at the start of remedial action activities, as well as the plume boundary based on the most recent groundwater monitoring event. Figure 4 overlays the PCE plumes generated by the groundwater modeling of the various layers by JSAI and shows the consistency in the two analyses. In May 2012, the eastern extent of the plume was east of I-25. In May 2013, the easternmost extent of plume was well to the west of I-25. The PCE concentration in GWMW-10 was 47 µg/L in May 2012, but below detection levels during the May 2013 sampling event. This well is approximately 700 feet east of CLC 27.

2.3 System Optimization

System optimization includes two key components:

- Adjusting the pumping strategy to maximize the concentrations of PCE and other COCs in the raw to the treatment plant, while at the same time minimizing the volume of water treated

- Ensuring that the treatment plant is efficiently removing all COCs from the raw and returning potable water to the public water system

The decreasing PCE concentrations detected in CLC 18 are most likely a result of dilution with clean water. Preconstruction PCE concentrations on the order of 60 µg/L were measured when CLC 18 was being pumped intermittently. During spring of 2013, the JSP worked with JSAI to evaluate the efficiency of CLC 18 and to make recommendations regarding changes to the pumping strategy for this well. The evaluation performed by JSAI included pumping CLC 18 at various rates and collecting groundwater samples that were analyzed for VOCs and total dissolved solids.

Explanation

- MonitorWell
- CLC supply well
- **MW-4** Well designation
- JSAI Layer 1 PCE plume
- JSAI Layer 2 PCE plume
- JSAI Layer 3 PCE plume

Source: National Agricultural Imagery Program August 2009. Downloaded from RGIS.

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GRIGGS-WALNUT GROUND WATER PLUME SITE
REMEDIAL ACTION
Plume Overlays

Daniel B. Stephens & Associates, Inc.
10/14/2013
JN ES09.0306

Figure 4

Using the recently collected data in addition to previous pumping data and modeling results, JSAI concluded that pumping CLC 18 at a rate of 170 gallons per minute (gpm) for 4 to 5 hours and letting the well recover will maximize removal rates. In this report, JSAI also proposed that the pumping rate of CLC 27 be maximized as well, to see if doing so will maximize the PCE removal from that well. The JSAI report also recommended that an additional monitor well with two ports (one for Layer 1 and one for Layer 2) be installed between and north of wells CLC 18 and CLC 27 to obtain additional data to confirm plume distribution and track remediation progress. A complete copy of the JSAI report is provided as Appendix A.

2.4 Progress Toward Attaining Performance Standards

The JSP has met all performance standards to date, including submitting all documents required by the scope of work (SOW) from the Modified Administrative Order. The JSP has consistently operated the remediation system to extract PCE-contaminated water and treat it to concentrations below the MCL.

The uranium concentrations in CLC 18 and CLC 27 are below the EPA MCL of 30 µg/L. Arsenic concentrations in wells CLC 18 and CLC 27 are below the EPA MCL of 10 µg/L. No additional treatment to remove these contaminants is required at this time.

Although PCE degradation products, benzene, and uranium were discussed in the ROD, the only remediation goal established was the SDWA MCL of 5 µg/L for PCE. The remediation goal is being met by the complete removal of PCE and removal of TCE, cis-1,2-DCE, and trans-1,2-DCE to concentrations below MCLs by the air stripper (Table 4). Additionally, the extent of groundwater with PCE concentrations higher than the remediation goal is decreasing, as discussed in Section 2.5.

2.5 Progress Toward Remedial Action Objectives

As outlined in the site ROD, the RAOs for groundwater at the GWP site were established in accordance with the Presumptive Response Strategy and Ex Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites, and are provided as follows:

- Prevent human exposure to contaminated groundwater with PCE concentrations above the MCL (5 µg/L).
- Maintain capture of the PCE-contaminated groundwater plume above the MCL (5 µg/L) for PCE.
- Restore groundwater to its beneficial use as a drinking water supply with PCE concentrations no greater than the MCL (5 µg/L).

To address the first RAO, the JSP worked with the OSE to put a new well drilling moratorium in place for the area in and adjacent to the PCE plume at the GWP site. The CLC has ceased pumping wells that are within the plume that are not part of the extraction system for the GWP site. These two measures are effectively addressing this RAO.

3. Conclusions

Significant progress has been made toward achieving RAOs:

- More than 234,392,638 gallons of groundwater have been extracted from the dissolved-phase plume at the GWP site.
- More than 14 pounds of PCE have been removed from the extracted groundwater.
- COCs have not been detected in the treated groundwater that has been returned to the PWS distribution system at the Griggs Reservoir.
- Groundwater monitoring has shown that the PCE plume has decreased significantly in volume.

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Appendix A

Shomaker Report

FIRST YEAR (MAY 2012 TO MAY 2013) ASSESSMENT OF THE GRIGGS AND WALNUT PCE PLUME CAPTURE WELLS AND RECOMMENDATIONS FOR OPTIMIZING CAPTURE EFFICIENCY

prepared by

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EXECUTIVE SUMMARY

John Shomaker & Associates, Inc. (JSAI) was contracted by the Griggs and Walnut Joint Superfund Project (Doña Ana County and City of Las Cruces) to assess the Griggs and Walnut tetrachloroethene (PCE) plume, to provide recommendations for optimizing efficiency of the pump and treat system by determining how to maximize capture efficiency from Wells 18 and 27, and to improve remedial progress.

Historic water-level and PCE-concentration data were evaluated by hydrogeologic zone and model layer. The hydrogeologic zones presented in the RI/FS by EPA (2006) are slightly different than layers in the Griggs and Walnut groundwater-flow and solute-transport model. A summary of the hydrogeologic zones for model Layers 1 through 3 are illustrated on Figures 4 and 5.

PCE concentrations in water produced from Well 18 decreased from 70 micrograms per liter (µg/L) to 2.3 µg/L between April and December 2012 (Fig. 2). PCE concentrations in water from Well 27 have remained fairly constant at around 14 µg/L. Results of performance analysis of Well 18 indicate pumping at a rate of 170 gpm for 4 to 5 hours per day will optimize the capture of high concentrations of PCE in groundwater from Layer 1. Tracking capture efficiency of Well 18 can be easily performed by field measurements of pumping rate, water level, and specific conductance. The pumping rate at Well 27 is currently averaging 110 gpm, and the PCE concentration continues to slowly increase with time (Table 1). Well 27 appears to be adequately capturing the PCE plume in Layers 2 and 3.

Historically, the PCE plume moved from west to east in Layer 1 until it was able to migrate vertically into Layers 2 and 3 where Layer 1 lacks a significant clay layer (hydraulic barrier to vertical flow). The first year of the Griggs and Walnut capture pumping and data collection has provided evidence that the plume is decreasing in size and remedial progress is being made.

Past definition of the extent of the PCE plume has been skewed by correlating results from GWMW-01 to other wells around the perimeter of the PCE plume. The PCE concentrations at GWMW-01 were influenced by recharge from Layer 1 to Layers 2 and 3 through the gravel pack annulus of Well 18. The revised estimated total PCE mass in groundwater equals 21.4 kg, and the potential removal rate from Wells 18 and 27 is 0.46 kg/month. With continued capture efficiency of the PCE plume, the remediation will progress as anticipated or sooner.

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TABLES

ILLUSTRATIONS

(follow text)

APPENDICES
(follow illustrations)

FIRST YEAR (MAY 2012 TO MAY 2013) ASSESSMENT OF THE GRIGGS AND WALNUT PCE PLUME CAPTURE WELLS AND RECOMMENDATIONS FOR OPTIMIZING CAPTURE EFFICIENCY

1.0 INTRODUCTION

John Shomaker & Associates, Inc. (JSAI) was contracted by the Griggs and Walnut Joint Superfund Project (Doña Ana County and City of Las Cruces) to assess the Griggs and Walnut tetrachloroethene (PCE) plume and provide recommendations for optimizing efficiency of the pump and treat system. The primary project goal is to assist the Griggs and Walnut Joint Superfund Project (JSP) with determining how to maximize capture efficiency from Wells 18 and 27, and to improve remedial progress. Site location map is presented as Figure 1.

1.1 Background

The Griggs and Walnut pump and treat system began during May 2012, and it has been operated near continuously. Since December 2012, Well 18 has yielded lower-than-expected PCE concentrations, and Well 27 has averaged better-than-expected PCE concentrations.

JSAI has reviewed the daily meter readings and the PCE concentration trends from Wells 18 and 27, and has performed diagnostic pumping tests on Well 18 (March 7, 2013). PCE concentrations in water produced from Well 18 decreased from 70 micrograms per liter (µg/L) to 2.3 µg/L between April and December 2012; unfortunately no PCE data were collected from Well 18 between June and November 2012. PCE concentrations in water from Well 27 have remained fairly constant at around 14 µg/L. Around September 2012, the pumping schedule for Wells 18 and 27 was modified so the wells would pump more continuously and eliminate the on-off effect of pumping Well 18 on the treatment system storage and flow rate. From September 2012 to current time, the pumping system has been operating near continuously at 360 gallons per minute (gpm), with Well 18 pumping at 240 gpm and Well 27 pumping at 110 gpm. Results from the diagnostic pumping test performed on Well 18 indicate well performance has not significantly changed. It was highly suspected that PCE concentrations from Well 18 are influenced by well hydraulics and affected by pumping rate and pumping schedule.

1.2 Scope of Work

The scope of work included the following tasks:

1. Provide recommendations for data collection from Wells 18 and 27, and the surrounding monitoring network.
2. Evaluate PCE-concentration and water-level data collected from the monitoring network, and determine how the PCE plume has responded to the last year of capture pumping. This task also includes revisiting the calculation of PCE mass remaining in groundwater and PCE mass removed.
3. Incorporate the data collected into the Griggs and Walnut groundwater-flow and solute-transport model, and re-access plume capture.

2.0 DATA SOURCES

Data sources used for this evaluation include operational data from the Griggs and Walnut plume treatment system, data collected from the monitoring well network, data collected during Well 18 optimization testing, and data from the City of Las Cruces water-level monitoring program.

2.1 Wells 18 and 27 Operational Data

Pumping Wells 18 and 27 for PCE plume capture and treatment began approximately 1 year ago. In 2009, Wells 18 and 27 were modified by performing partial plug back so pumping would occur from the upper screen section without contributions from the lower screen section. Following modification, step-drawdown pumping test and water-quality analyses were performed on Wells 18 and 27. Details can be referenced from JSAI (2009). Well 18 was equipped to pump 200 gpm, as recommended by JSAI (2009).

Pumping duration and average daily pumping rate varied as the treatment system was undergoing start up evaluation between May 2012 and August 2012. Since start up, water level, metered diversions, and PCE concentration data have been collected from Wells 18 and 27. Figure 2 is a time-series graph showing pumping rates and PCE concentrations measured from Wells 18 and 27. During March 2013, JSAI performed a diagnostic pumping test on Well 18; the results are shown as Figure 3.

2.2 Griggs and Walnut Monitoring Network and Water Quality

The Griggs and Walnut JSP collected water-level and water-quality data from the monitoring well network during April and May 2013 (summary tables can be referenced from Appendix A). Several of the monitoring wells in the vicinity of the County Yard were not accessible or had collapsed. Laboratory detection limit results from GWMW-09 were affected by the required 10-fold dilution to mitigate the soapy nature of the samples. Table 1 is a comparison of 2005, 2007, 2009, and 2013 PCE concentration data from the monitoring well network.

General chemistry data from Well 18 and other selected wells can be referenced from Appendix B. General chemistry includes major ions, total dissolved solids (TDS), pH, and specific conductance.

2.3 Las Cruces Water-Level Monitoring Program

During 2011, the City of Las Cruces implemented a detailed water-level monitoring program that included data collection training for staff, QA/QC evaluation of collected data, and equipping several observation wells with continuous water-level monitoring. Selected hydrographs for City wells monitored in the Griggs and Walnut plume area are presented in Appendix C. Well locations can be referenced from Figure 1.

Table 1. Summary of 2005, 2007, 2009, and 2013 PCE results from selected wells at the Griggs and Walnut site

sample ID	2005 PCE (µg/L)	2007 PCE (µg/L)	2009 PCE (µg/L)	2013 PCE (µg/L)
CLC-18	**35.0**	**33.0**	**48.0**	2.7
CLC-20	---	---	---	<1.0
CLC-26*	---	---	---	<1.0
CLC-27		3.0	**11.0**	**14.0**
CLC-57*	---	---	---	<1.0
Paz Park	---	---	---	<1.0
MW-1	0.2	---	---	<5.0
MW-3	**6.4**	---	---	2.4
MW-4	1.0	---	---	4.2
MW-5	0.5	---	---	<1.0
MW-SF2	**8.3**	**14.0**		**7.4**
MW-SF5*	1.7	---	---	<1.0
MW-SF6	0.4	---	---	<1.0
MW-SF9	<0.5	**9.0**	---	<1.0
MW-SF10	**17.0**	---	---	**10.0**
GWMW-11S	<0.5	1.0	<1.0	<1.0
GWMW-11I	<0.5	<1.0	<1.0	<1.0
GWMW-11D	<0.5	<1.0	<1.0	<1.0
GWMW-15S	**18.0**	**8.8**	2.6	<1.0
GWMW-15I*	<0.5	<1.0	<1.0	<1.0
GWMW-15D	<0.5	<1.0	<1.0	<1.0
GWMW-01(Port 1)	**5.3**	**19.0**	---	**11.0**
GWMW-01(Port 2)	**21.0**	**8.7**	---	<1.0
GWMW-01(Port 3)*	1.0	<1.0	---	3.2
GWMW-01(Port 4)	2.0	<1.0	---	<1.0
GWMW-01(Port 5)	3.4	2.6	---	<1.0
GWMW-01(Port 6)	**6.2**	2.7	---	**14.0**
GWMW-01(Port 7)	2.1	3.5	---	3.6

* duplicate sample collected during 2013
bold values are detections above 5 micrograms per liter (µg/L)
--- indicates no sample results

Table 1. Summary of 2005, 2007, 2009, and 2013 PCE results from selected wells at the Griggs and Walnut site (concluded)

sample ID	2005 PCE (µg/L)	2007 PCE (µg/L)	2009 PCE (µg/L)	2013 PCE (µg/L)
GWMW-03(Port 1)*	0.3	1.6	1.6	<1.0
GWMW-03(Port 2)	0.5	1.2	<1.0	<1.0
GWMW-03(Port 3)	<0.5	<1.0	<1.0	<1.0
GWMW-03(Port 4)	<0.5	---	<1.0	<1.0
GWMW-03(Port 5)	---	---	<1.0	<1.0
GWMW-03(Port 6)	---	---	---	<1.0
GWMW-08(Port 3)*	<0.5	---	---	<1.0
GWMW-08(Port 4)	<0.5	---	---	<1.0
GWMW-08(Port 5)	<0.5	---	---	<1.0
GWMW-08(Port 6)	<0.5	---	---	<1.0
GWMW-08(Port 7)	<0.5	---	---	<1.0
GWMW-09(Port 1)*	0.6	**11.0**	<1.0	<4.9
GWMW-09(Port 2)	**19.0**	<1.0	**13.0**	<9.8
GWMW-09(Port 3)	**14.0**	**8.4**	**9.0**	<4.9
GWMW-09(Port 4)	**16.0**	**17.0**	**29.0**	<1.0
GWMW-09(Port 5)	**18.0**	**15.0**	**20.0**	<4.9
GWMW-09(Port 6)	0.2	**27.0**	<1.0	<4.9
GWMW-09(Port 7)	<1.8	**30.0**	<1.0	<4.9
GWMW-10(Port 1)	3.2	**50.0**	**31.0**	<1.0
GWMW-10(Port 2)	**14.0**	**33.0**	**36.0**	**7.1**
GWMW-10(Port 3)	**16.0**	**62.0**	**46.0**	**42.0**
GWMW-10(Port 4)	**14.0**	**17.0**	**15.0**	3.7
GWMW-10(Port 5)*	0.2	<1.0	<1.0	<1.0
GWMW-10(Port 6)	0.4	<1.0	<1.0	<1.0
GWMW-10(Port 7)	0.2	<1.0	<1.0	<1.0

* duplicate sample collected during 2013
bold values are detections above 5 micrograms per liter (µg/L)
--- indicates no sample results

3.0 DATA EVALUATION

Water-level and PCE-concentration data were evaluated by hydrogeologic zone and model layer. The hydrogeologic zones presented in the Remedial Investigation/Feasibility Study (RI/FS) by EPA (2006) are slightly different than layers in the Griggs and Walnut groundwater-flow and solute-transport model. A summary of the hydrogeologic zones for model Layers 1 through 3 is as follows:

1. Model Layer 1 represents the Upper Hydrogeologic Zone that is an unconfined aquifer consisting of sand and gravel.

2. Model Layer 2 represents the upper portion of the Lower Hydrogeologic Zone that primarily consists of a silt and clay beds. EPA (2006) had identified model Layer 2 as part of the Lower Hydraulic Zone. The low-permeability beds (where present) limit hydraulic communication between the Upper Hydrogeologic Zone and the Lower Hydrogeologic Zone. The silt and clay beds in Layer 2 transition east of Well 18 to silt and sand.

3. Model Layer 3 represents the lower portion of the Lower Hydrogeologic Zone consisting of sand and gravel.

The layer designation for each well can be referenced from Table A2 in Appendix A. Cross-sections showing the comparison of the EPA hydrogeologic zones and model layers are shown as Figures 4 and 5. The correlation of model layers and screened intervals at Well 18 and GWMW-01 is shown on Figure 4, and the correlation of model layers and screened intervals at Well 27 and GWMW-10 is shown on Figure 5. The thickness and extent of the low-permeability silt and clay beds in Layer 2 have controlled the lateral migration and vertical distribution of PCE in groundwater. At Well 18, Layer 2 creates a hydraulic barrier to vertical flow, and at Well 27, Layer 2 contains enough silt and sand to allow for vertical groundwater flow.

Historically, the PCE plume moved from west to east in Layer 1 until it was able to migrate vertically into Layers 2 and 3, where Layer 1 lacks a significant clay layer (hydraulic barrier to vertical flow).

3.1 Water-Level Response to Pumping

Available water-level data from the Griggs and Walnut plume area were evaluated to determine hydraulic gradient, direction of groundwater flow, and drawdown caused by pumping Wells 18 and 27 (Table A2, Appendix A). Local direction of groundwater flow is difficult to discern because the hydraulic gradient is relatively flat, and because there is a downward head gradient due to regional pumping. Water-level elevation contours for Layer 1 are presented on Figure 6, and water-level elevation contours for Layer 3 are presented on Figure 8, while there are not enough data points to create water-level elevation contours for the low-permeability sediments of Layer 2.

The monitoring well network was used to create the water-level elevation contours for Layer 1 (Fig. 6). The water-level data are summarized in Appendix A. The direction of lateral groundwater flow in Layer 1 is west to east, with a hydraulic gradient of 0.0028 ft/ft. Only the 3,845- and 3,850-ft water-level elevation contours could be defined from the dataset. East of Well 18, Layer 1 becomes coarser-grained and there is a vertical component of flow into Layers 2 and 3.

Table 2. Summary of water-level data from City of Las Cruces water supply wells in the vicinity of Griggs and Walnut plume

well	elevation (ft amsl)	depth to water Apr 2012 (ft bgl)	depth to water Apr 2013 (ft bgl)	water-level elevation Apr 2012 (ft amsl)	water-level elevation Apr 2013 (ft amsl)	accumulated drawdown (ft)
Paz Park	4,013.0	168.15	168.15	3,844.85	3,844.85	0.00
Well 10	3,936.0	91.00	92.60	3,845.00	3,843.40	1.60
Well 21	4,076.2	230.90	233.40	3,845.25	3,842.75	2.50
Well 19	4,065.5	221.10	222.60	3,844.40	3,842.90	1.50
Well 54	4,110.0	266.00	266.40	3,844.00	3,843.60	0.40
Well 57	4,130.0	284.85	287.95	3,845.15	3,842.05	3.10
Well 20	4,072.0	232.80	235.90	3,839.20	3,836.10	3.10
Well 27*	4,050.0	213.00	227.60	3,837.00	3,822.40	14.60
Well 18*	4,035.6	192.00	229.50	3,843.60	3,806.10	37.50
Well 61	4,038.5	198.65	197.75	3,839.85	3,840.75	-0.90

* capture wells
ft amsl - feet above mean sea level
ft bgl - feet below ground level

Layer 3 water-level elevation contours are shown on Figure 8. The cone of depression (drawdown) caused by Wells 18 and 27 is illustrated by the water-level elevation contours from Layer 3. The horizontal hydraulic gradient outside of the 3,835-ft water-level elevation contour is generally flat as indicated by the water-level elevation range of 3,836 to 3,845 ft in City wells surrounding the Griggs and Walnut site (Table 2).

3.2 PCE Plume Configuration and Mass

Over the past 8 years, the relatively flat hydraulic gradient across the Griggs and Walnut site and focused pumping from capture wells (18 and 27) has kept the PCE plume in the general vicinity between Well 18 and Interstate 25. Groundwater monitoring results from GWMW-09 (Ports 1-7), GWMW-10 (Ports 1-7), and GWMW-15S have shown a retreat of the eastern extent of the PCE plume and overall plume reduction (see results in Table 1). It has also become apparent that results from GWMW-01 (Ports 2-7) are influenced by Well 18 pumping cycles. When Well 18 is not pumping, the high PCE concentrations in Layer 1 are recharging Layers 2 and 3 by migration through the gravel packed annulus of Well 18. The elevated PCE concentrations in Layers 2 and 3 around Well 18 are then removed by pumping Well 18. The results from GWMW-01 (Ports 2-7) cannot be extrapolated to other monitoring points, because the PCE plume in Layers 2 and 3 is temporarily localized around Well 18 during periods of non-pumping.

The configuration of the 2013 PCE plume is shown by layer on Figures 6, 7, and 8. The PCE plume (>5 micrograms per liter; µg/L) in Layer 1 appears to be narrow, extending between Well 18 and MW-SF10 (Fig. 6). The extent of PCE in Layer 1 is well defined in the vicinity of Wells 18 and 27, but lacking definition midway between GWMW-01 and MW-SF10. The average PCE concentration in Layer 1 is estimated at 20 µg/L, with the highest PCE concentration of 70 µg/L observed from Well 18 (Fig. 2).

The PCE plume (>5 µg/L) in Layer 2 occurs where Layer 2 becomes coarser grained east of Well 18, and there is vertical downward groundwater flow between Layers 1 and 2 (Fig. 7). The extent of PCE in Layer 2 is defined by monitoring points GWMW-01, GWMW-08, GWMW-09, GWMW-10, GWMW-11I, GWMW-15I, Well 19, and Well 27. The average PCE concentration in Layer 2 is estimated at 15 µg/L, with the highest PCE concentration of 42 µg/L observed at GWMW-10 (Port 3).

The PCE plume (>5 µg/L) in Layer 3 occurs beneath the Layer 2 PCE plume where there is vertical downward groundwater flow between Layers 2 and 3 (Fig. 8). The extent of PCE in Layer 3 is defined by monitoring points GWMW-01, GWMW-08, GWMW-09, GWMW-10, GWMW-11D, GWMW-15D, and Well 27. The average PCE concentration in Layer 3 is estimated at 10 µg/L, with the highest PCE concentration of 14 µg/L observed at Well 27.

The estimated 2005 PCE plume mass was 152 kilograms (kg) when using an effective porosity of 20 percent and 2005 monitoring results (JSAI, 2006). The calculated PCE plume mass was re-evaluated using the lateral extent of 2013 PCE concentrations for each layer (shown on Figs. 6 through 8), layer thickness, and average observed 2013 PCE concentration. The calculated 2013 PCE plume mass is 21.4 kg (Table 3). The large discrepancy between the calculated PCE mass for 2005 and 2013 is reflected in the smaller horizontal and vertical extent of the 2013 PCE plume.

Table 3. Revised estimates of the volume of groundwater containing PCE and the current mass of PCE in groundwater at the Griggs and Walnut site

layer	average thickness (ft)	2013 plume area (ft^2)	volume of groundwater (liters)*	estimated average PCE concentration (µg/L)	revised PCE mass (kg)
1	30	997,500	169,457,750	20	3.4
2	80	900,000	407,717,122	15	6.1
3	200	1,050,000	1,189,175,085	10	11.9
					21.4

* Using an effective porosity of 20 percent
µg/L - micrograms per liter
kg - kilograms

3.3 Well 18 Performance

Well 18 experienced significant variations in PCE concentrations during the first year of pumping (April 2012 to February 2013; Fig. 2). All available data from the first year of pumping were reviewed, and performance testing and analysis of the capture efficiency for Well 18 were performed. The primary issue with Well 18 was the reduction in PCE concentration that occurred between June and December of 2012 (Fig. 2).

A diagnostic pumping test on Well 18 was performed during March 2013 (Fig. 3). The well appeared to be operating as originally designed for the project, but the source of water had a different chemistry than the November 2010 testing performed after the back plugging. Well 18 was pumped at rates between 160 and 240 gpm during the March 2013 testing, and pumped at rates of 124 to 188 gpm during the November 2010 testing. The change in chemistry is indicated by a change in TDS content. Higher PCE concentrations correlate with higher TDS concentrations. For example, the TDS was 1,279 milligrams per liter (mg/L) when yielding PCE concentrations greater than 30 µg/L, and the TDS was less than 430 mg/L when yielding PCE concentrations less than 5 µg/L. In nearby monitoring well GWMW-01, TDS concentration of 1,300 mg/L has been observed in the shallow Port 1, and TDS concentrations less than 430 mg/L have been observed in the deeper Ports 2-7. Additional data collection between March and July 2013 was performed to better define the relationship between specific conductance (an approximation of TDS) and PCE concentration. The relationship between specific conductance and PCE concentration is shown on Figure 9.

An assessment of the well hydraulics revealed that Well 18 yields water from horizontal flow through the screen interval (315 to 516 ft), and from vertical flow through the saturated gravel pack in the annulus between the formation and well casing above the screen interval (199 to 315 ft; Fig. 4). The component of vertical flow through the gravel pack is estimated at 40 gpm (see Appendix D). The part of the aquifer yielding vertical flow through the gravel pack is a sand and gravel layer from about 190 to 220 ft below ground level (bgl) overlying a clay zone. When pumping levels in Well 18 are greater than 220 ft, the vertical flow stops because the gravel pack becomes partially unsaturated thereby reducing the hydraulic conductivity by several orders of magnitude creating a perched zone. When pumping stops and Well 18 is allowed to recover, the higher head perched zone recharges the gravel packed annulus, casing storage, and depressurized zone around the well.

Given the current assessment of Well 18 data, pumping the well continuously does not allow for maximum capture of the high PCE concentration zone near the water table. Pumping the well at a rate of 170 gpm for 4 to 5 hours per day will optimize the capture of high PCE groundwater. Approximately 4 kg of PCE have been captured from Well 18 as a result of plume containment pumping in 2006 and 2007, and plume capture and treatment during 2012 to current (see Fig. 10). Continued pumping at an average rate of 40 gpm (170 gpm 4 to 5 hours per day) with a PCE concentration of 30 µg/L would result in a PCE mass removal rate of 0.20 kg per month.

3.4 Well 27 Performance

The pumping rate from Well 27 is currently averaging 110 gpm, and the PCE concentration continues to slowly increase with time (Fig. 2). Well 27 appears to be adequately capturing the PCE plume in Layers 2 and 3.

Approximately 3 kg of PCE have been captured from Well 27 as a result of plume containment pumping in 2006 and 2007, and plume capture and treatment during 2012 to current (see Fig. 11). Continued pumping at an average rate of 110 gpm with a PCE concentration of 14 µg/L would result in a PCE mass removal rate of 0.26 kg per month. Increasing the pumping rate from Well 27 may increase the PCE mass removal rate.

4.0 GRIGGS AND WALNUT PLUME MODEL RESULTS

The Griggs and Walnut groundwater-flow and solute-transport model was used to simulate the last year of pumping from Wells 18 and 27. The original model by JSAI (2006) was used for the EPA feasibility study. The model was updated in 2009, and some minor modifications were made and reported by JSAI (2009).

4.1 Model Update

The historical-transient groundwater-flow model was updated to simulate pumping effects through April 2013. Model-simulated pumping from Wells 18 and 27 was re-allocated to the model layers representative of the back plugging and reconfigured screen intervals. From 2010 to current, both wells pump from model Layer 3, instead of model Layers 3 and 4.

4.2 Model-Simulated Capture

The capture zone is the area contributing flow to the pumping well(s). The shape of the capture zone is a function of the average linear groundwater velocity (as influenced by hydraulic gradient), the rate of groundwater pumping, and the distribution of hydraulic conductivity (Fetter, 1993). The up-gradient extent of the capture zone depends on the length of time which the pumping occurs.

April 2013 model-simulated capture zones for Layers 1, 2, and 3 are shown on Figures 6, 7, and 8. Well 18 is capturing the PCE plume in Layer 1, and Well 27 is capturing the PCE plume in Layers 2 and 3.

Future model runs indicate the potential of the PCE plume clean up in less than the anticipated time frame of pumping Well 18 at an average rate of 45 gpm and Well 27 at 180 gpm (Figs. 12 and 13).

5.0 FINDINGS

The first year of the Griggs and Walnut capture pumping and data collection has provided evidence that the plume is decreasing in size and remedial progress is being made. The capture efficiency issue with Well 18 has been investigated and resolved. Tracking capture efficiency of Well 18 can be easily performed by field measurements of pumping rate, water level, and specific conductance.

Past definition of the extent of the PCE plume has been skewed by correlating results from GWMW-01 to other wells around the perimeter of the PCE plume. The PCE concentrations at GWMW-01 were influenced by recharge from Layer 1 to Layers 2 and 3 through the gravel pack annulus of Well 18. The PCE plume at GWMW-09 and GWMW-15(S) has been pulled from east to west by capture pumping.

Revisions to the estimation of PCE mass in groundwater are based on the plume extent in Layers 1, 2, and 3 (see Figs. 6, 7, and 8). The revised estimated total PCE mass in groundwater is 21.4 kg, and the potential removal rate from Wells 18 and 27 combined is 0.46 kg/month. With continued capture efficiency of the PCE plume, the remediation will progress as anticipated or sooner.

6.0 RECOMMENDATIONS

The following actions are recommended:

1. Continue to collect data on pumping rate, water level, and specific conductance from Well 18, and use the data to track and optimize the PCE mass removal rate. The recommended pumping schedule for Well 18 is 170 gpm 4 to 5 hours per day.

2. Continue to collect data on pumping rate, water level, and PCE concentrations from Well 27, and use the data to track and optimize the PCE mass removal rate. It is recommended to increase pumping from Well 27 and see if PCE concentrations increase with increased pumping rate. Well 27 is currently pumping an average 110 gpm. Increase the average rate by 20 gpm/month until a maximum of 170 gpm is obtained or the pump is operating at peak rate.

3. Consider installing a monitoring well in the center of the plume area halfway between GWMW-01 and MW-SF10 (see location on Fig. 14). The proposed monitoring well should be a pair of wells; one with a shallow (Layer 1) screen, and the other with an intermediate (Layers 2 or 3) screen setting. The proposed monitoring well(s) would help confirm the current understanding of the PCE plume distribution, and help track plume capture and remedial progress.

7.0 REFERENCES

[EPA] U.S. Environmental Protection Agency, 2006, Remedial investigation report, Griggs and Walnut Ground Water Plume Superfund Site, Las Cruces, Doña Ana County, New Mexico, EPA ID NM0002271286: prepared by CH2M Hill, Inc.

Fetter, C.W., 1993, Contaminant Hydrogeology: Macmillan Publishing Company, New York, 458 p.

[JSAI] John Shomaker & Associates, Inc., 2006, Ground-water-flow and solute-transport model for the Griggs and Walnut Superfund Site, Las Cruces, New Mexico: consultant's report prepared by JSAI for City of Las Cruces and the Griggs and Walnut Joint Superfund Project, November 2006.

[JSAI] John Shomaker & Associates, Inc., 2009, Updates to the groundwater model and recommendations for using City of Las Cruces Wells 18 and 27 to capture and contain the Griggs and Walnut Plume: consultant's technical memorandum prepared by JSAI for City of Las Cruces and the Griggs and Walnut Joint Superfund Project, November 2009.

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ILLUSTRATIONS

Figure 1. Aerial photograph of the Griggs and Walnut plume site showing locations of capture wells and monitoring well network, City of Las Cruces, New Mexico.

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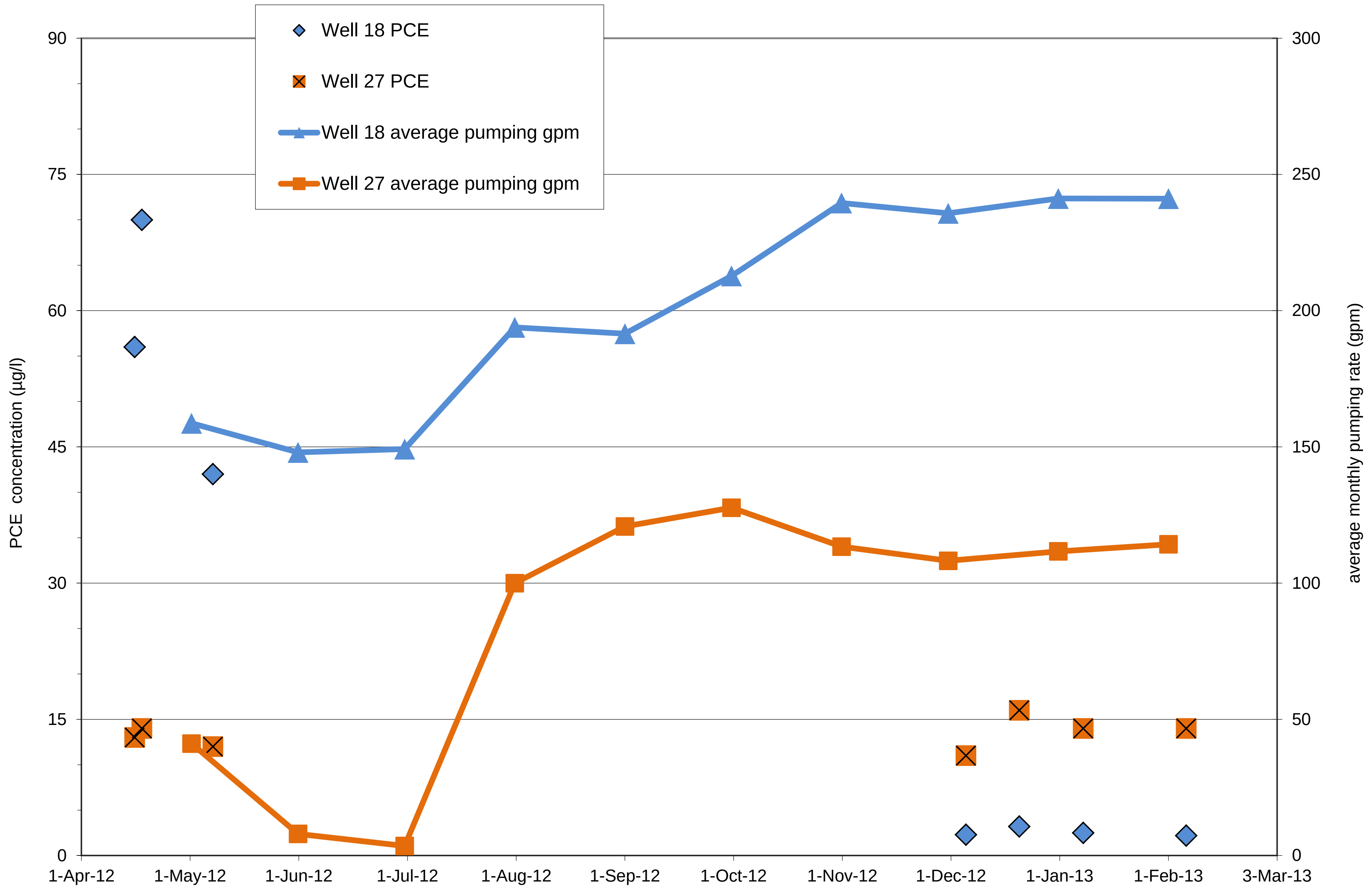

Figure 2. Time-series graph of pumping rate and PCE concentrations for Wells 18 and 27, Griggs and Walnut site, Las Cruces, New Mexico.

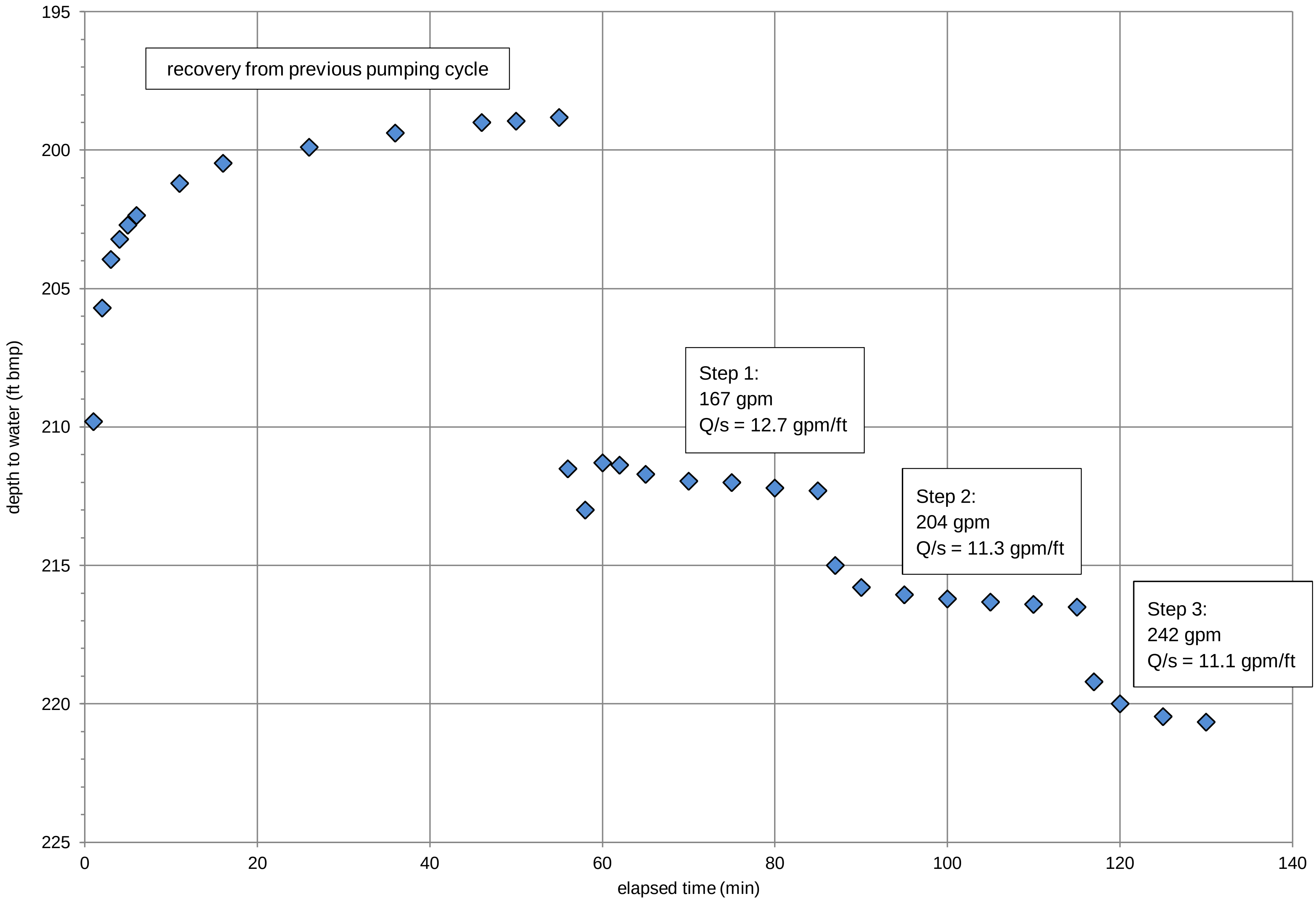

Figure 3. Graph of performance evaluation pumping test performed on Well 18, March 7, 2013, Griggs and Walnut site, Las Cruces, New Mexico.

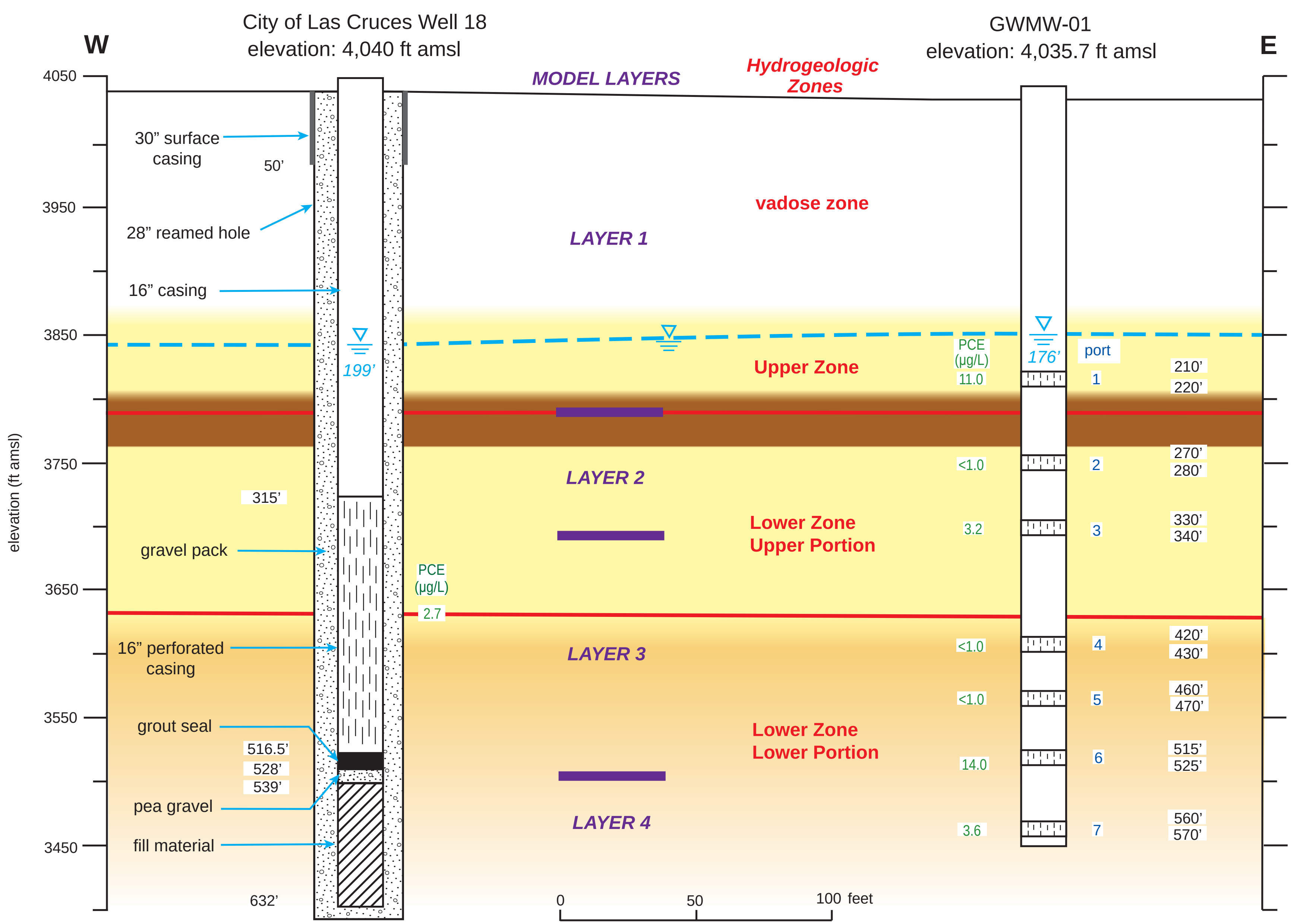

Figure 4. Hydrogeologic cross-section between Well 18 and GWMW-01 showing well completion details and distribution of 2013 PCE concentrations, Griggs and Walnut site, Las Cruces, New Mexico.

9/25/2013; DA,LM,KJ&PW

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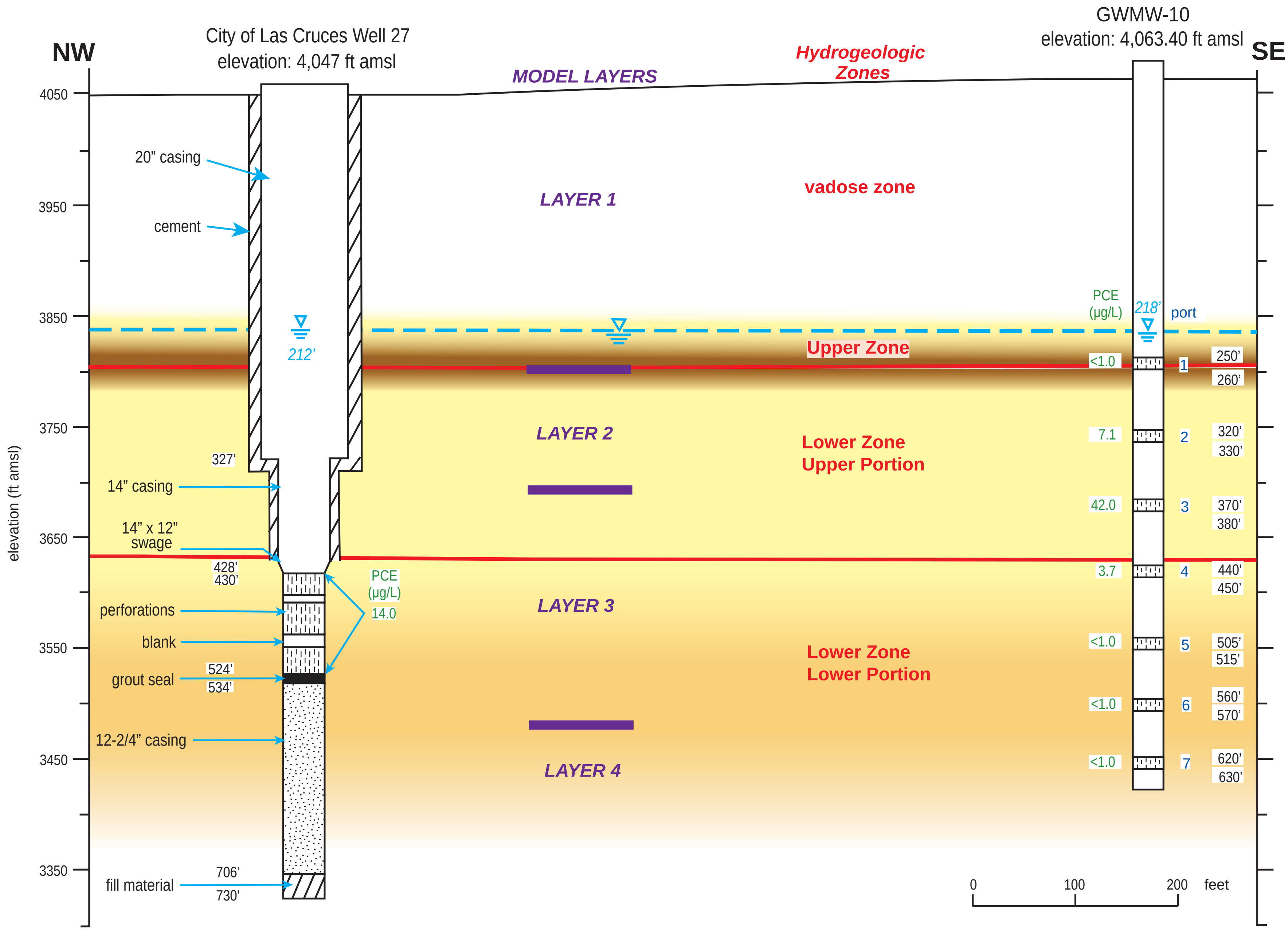

Figure 5. Hydrogeologic cross-section between Well 27 and GWMW-10 showing well completion details and distribution of 2013 PCE concentrations, Griggs and Walnut site, Las Cruces, New Mexico.

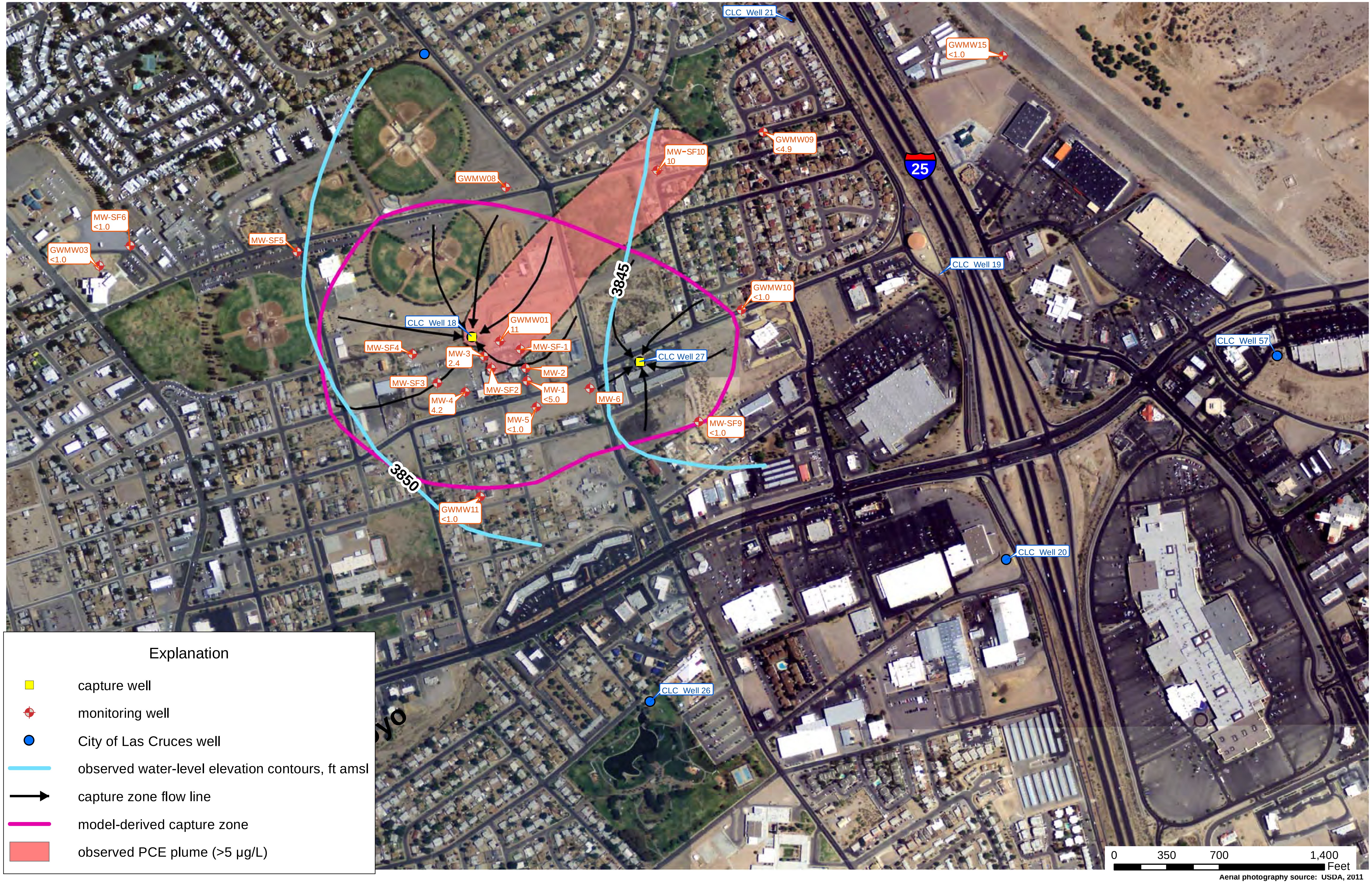

Figure 6. Aerial photograph showing model Layer 1 capture zone, capture flow lines, observed water-level elevation contours, and observed PCE plume, May 2013, Griggs and Walnut site, Las Cruces, New Mexico.

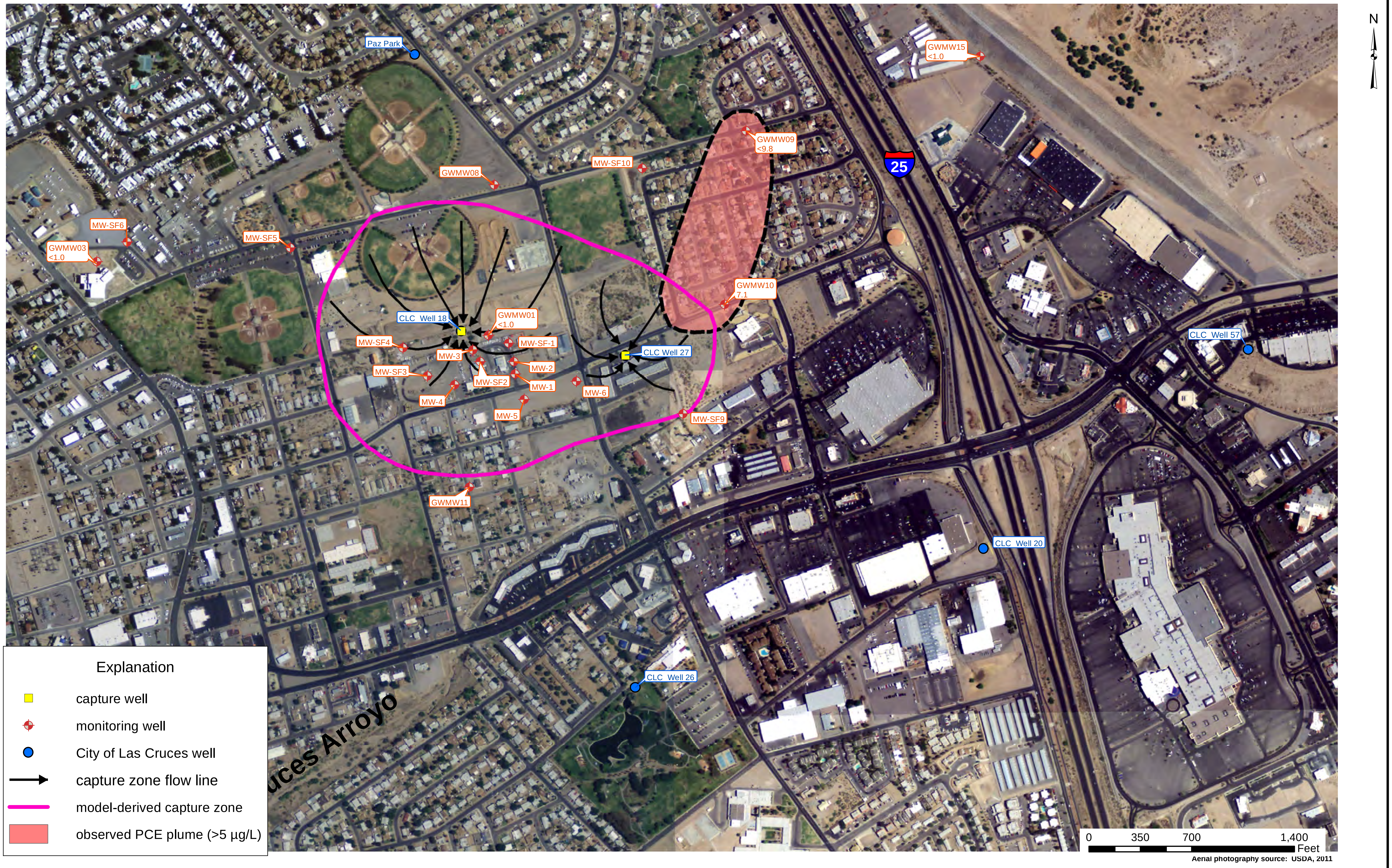

Figure 7. Aerial photograph showing model Layer 2 capture zone, capture flow lines, and observed PCE plume, May 2013, Griggs and Walnut site, Las Cruces, New Mexico.

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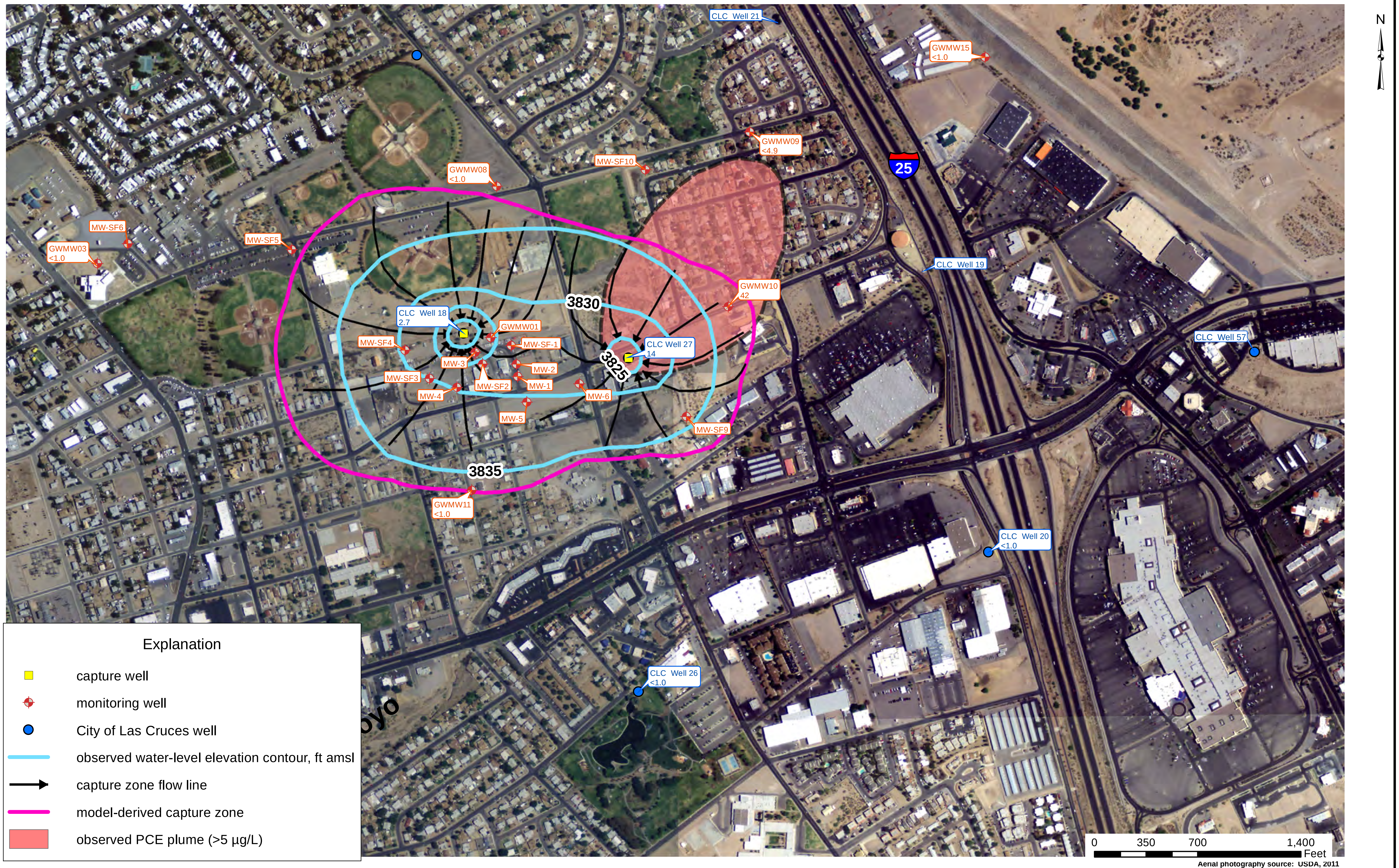

Figure 8. Aerial photograph showing model Layer 3 capture zone, capture flow lines, observed water-level elevation contours, and observed PCE plume, May 2013, Griggs and Walnut site, Las Cruces, New Mexico.

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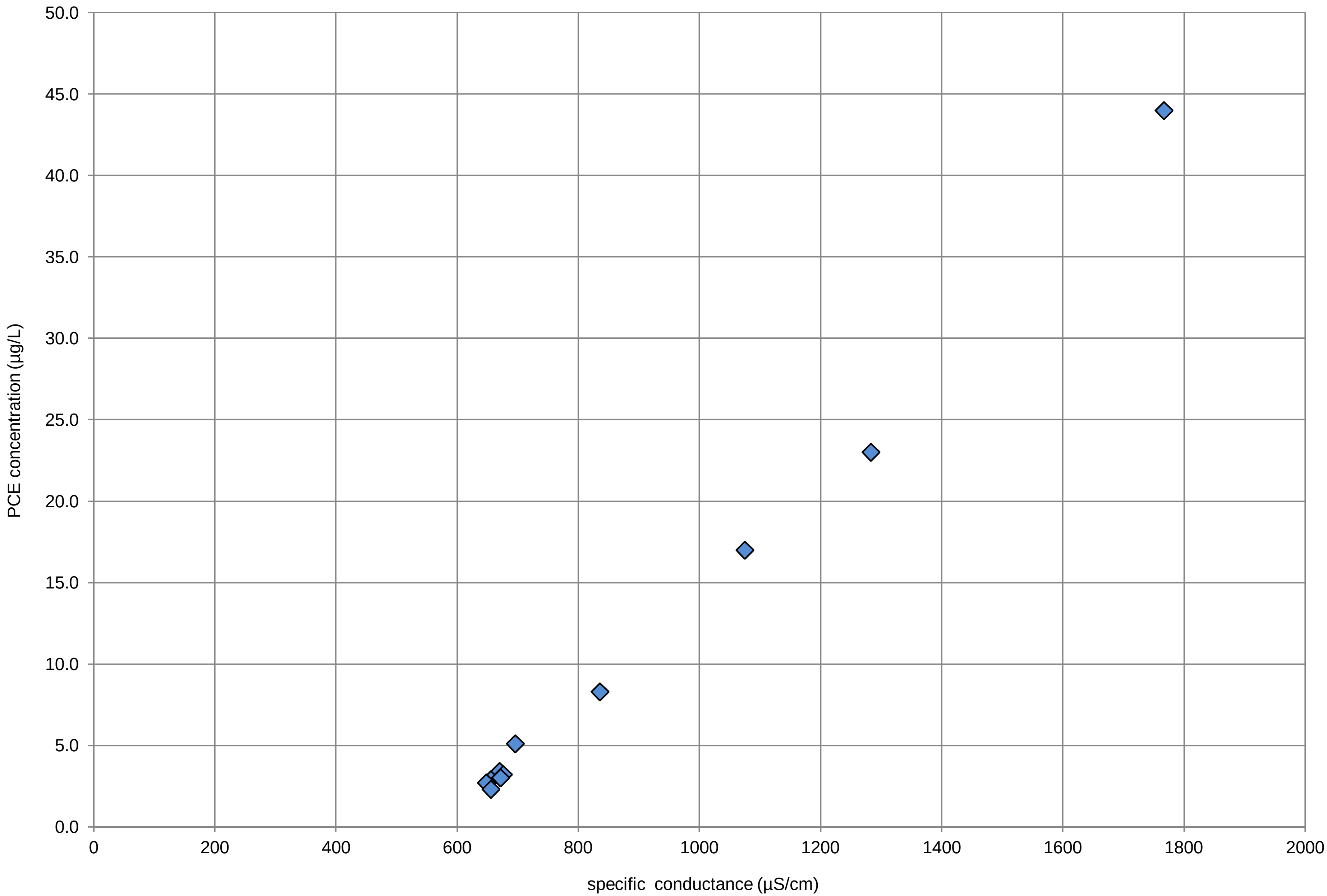

Figure 9. Graph of Well 18 PCE concentrations versus specific conductance, Griggs and Walnut site, Las Cruces, New Mexico.

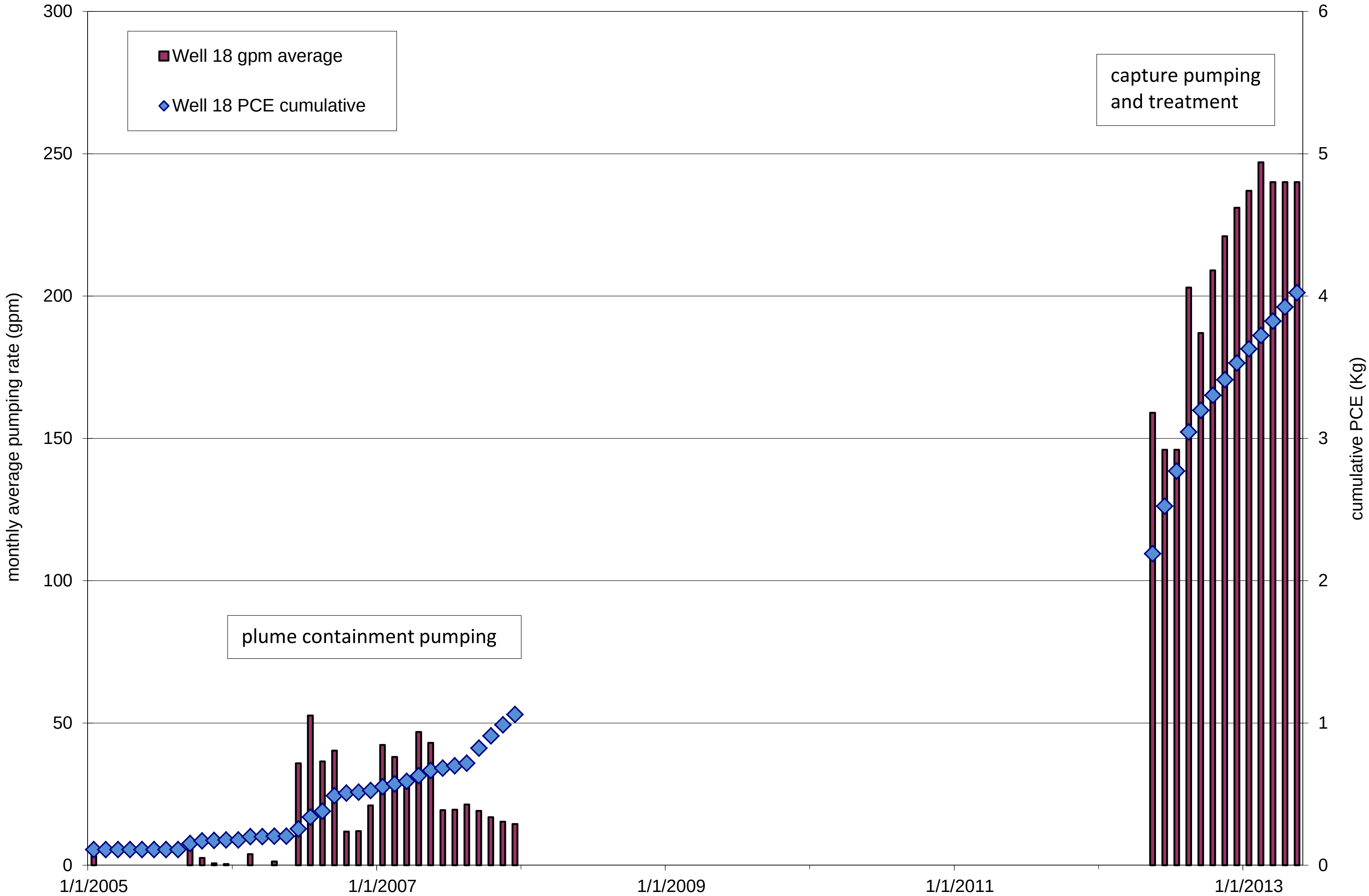

Figure 10. Graph of Well 18 average pumping rate and cumulative PCE mass removed for the time period January 2005 to May 2013, Griggs and Walnut site, Las Cruces, New Mexico.

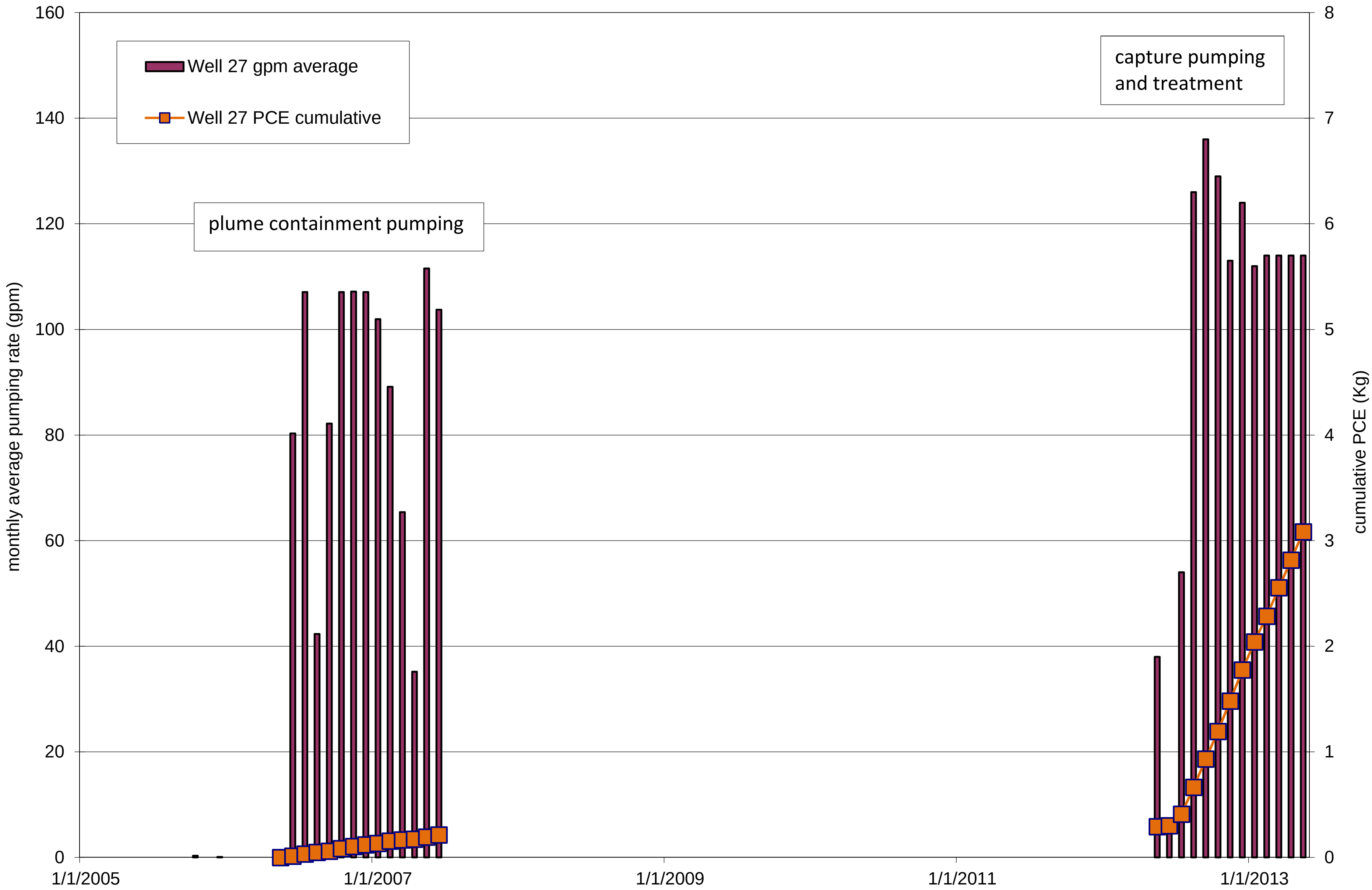

Figure 11. Graph of Well 27 average pumping rate and cumulative PCE mass removed for the time period January 2005 to May 2013, Griggs and Walnut site, Las Cruces, New Mexico.

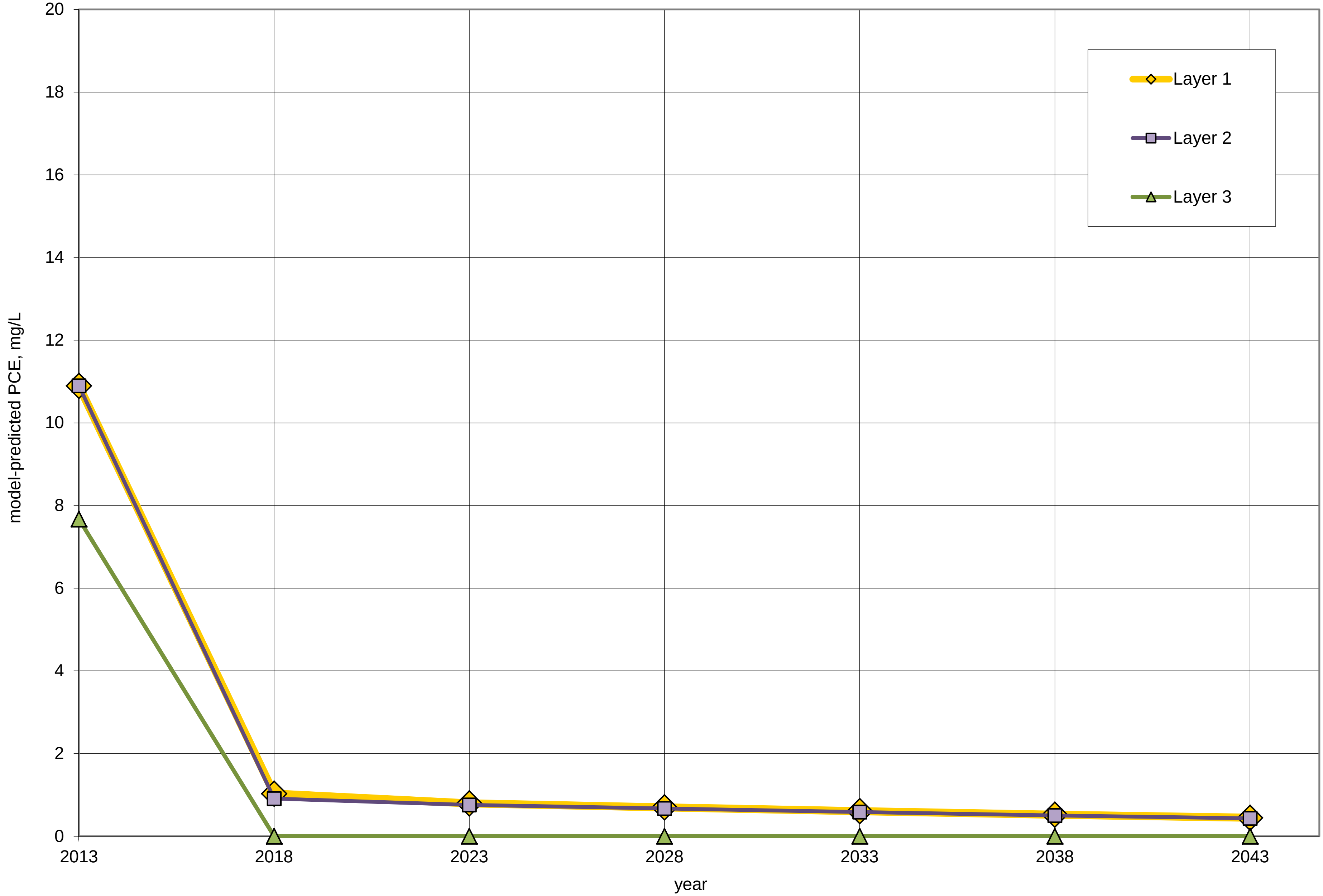

Figure 12. Graph of model-predicted PCE concentrations for Well 18 in Layers 1, 2, and 3, with Well 27 pumping at 180 gpm and Well 18 pumping at 45 gpm, Griggs and Walnut, Las Cruces, New Mexico.

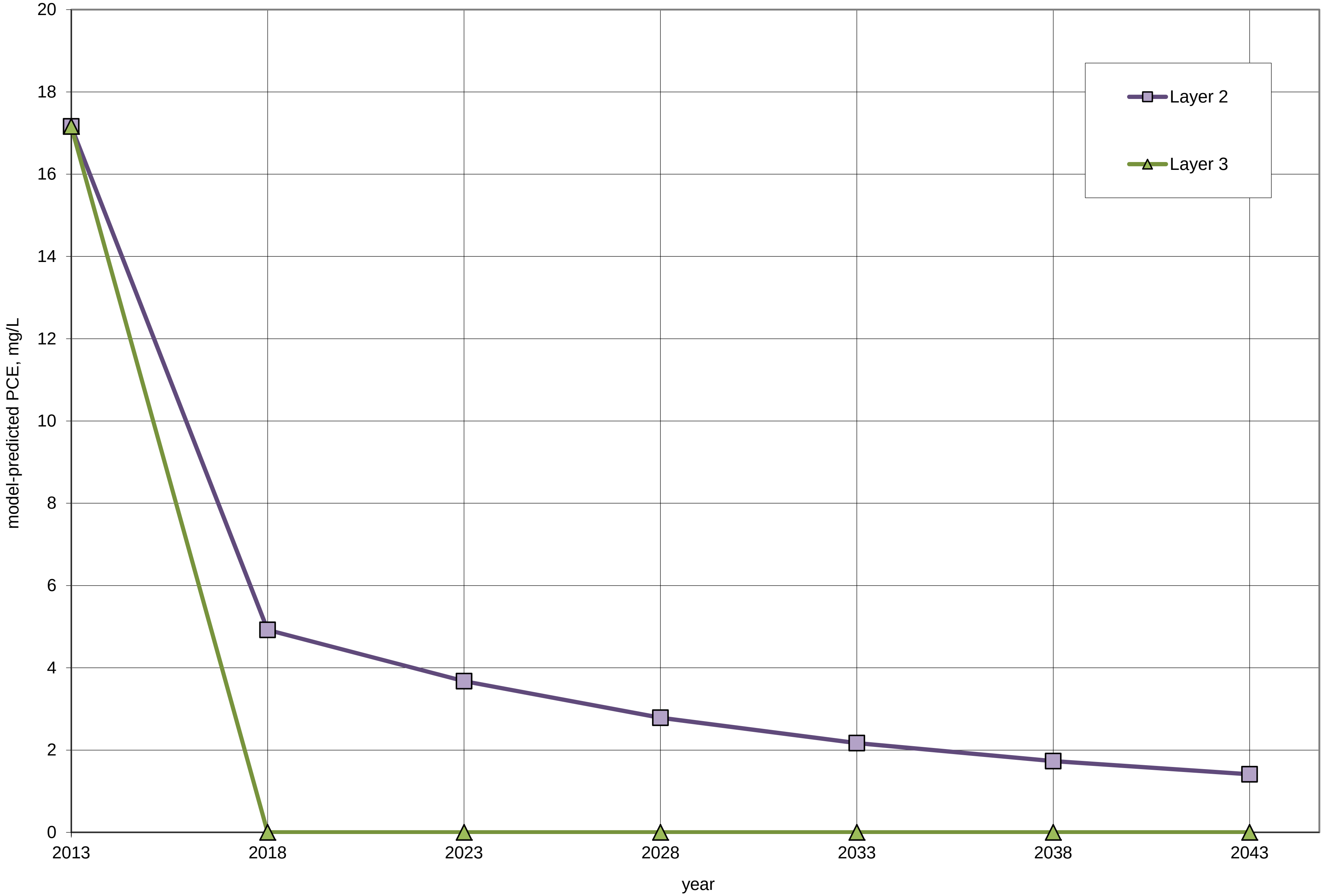

Figure 13. Graph of model-predicted PCE concentrations for Well 27 in Layers 2 and 3, with Well 27 pumping at 180 gpm and Well 18 pumping at 45 gpm, Griggs and Walnut site, Las Cruces, New Mexico.

Figure 14. Aerial photograph of the Griggs and Walnut plume site showing location of proposed monitoring well(s), City of Las Cruces, New Mexico.

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APPENDICES

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Appendix A.

City of Las Cruces summary data tables for 2013 sampling event

APPENDIX A.

TABLE A1. WELL SUMMARY (APRIL - MAY 2013 SAMPLING)

CLC-JSP Griggs-Walnut Groundwater Well Sampling

Water Quality Laboratory (April - May 2013)

						Field Parameters			
Sample Location	Sampling Date	Depth to Water (ft)	Sampling Technique	Screen Interval (ft)	Sampling Depth (ft)	pH (SU)	Temp (°C)	Conductivity (mS)	Comments
CLC 18	4/15/2013	-	Well Pump	380-516.5	380-516.5	6.93	22.0	0.709	Process Water: Unable to measure static level, enclosed pump.
CLC 20	5/23/2013	143.56	Hydrasleeve	380-395, 415-440, 450-525, 615-673	430	6.75	27.6	1.594	Most of oil has been removed and now can be sampled.
CLC 27	4/15/2013	-	Well Pump	430-730	430-730	6.86	23.6	1.186	Process Water: Unable to measure static level, enclosed pump.
GWMW01	5/8/2013	176.31	Compressed Nitrogen	210-220	210-220	6.81	22.4	2.240	
GWMW03	5/10/2013	95.08	Compressed Nitrogen	140-150	140-150	8.19	24.2	2.340	
GWMW08	5/3/2013	164.25	Compressed Nitrogen	190-200	190-200	-	-	-	Unable to sample: Leaking gas feed line to port tubing.
GWMW09	5/13/2013	196.00	Compressed Nitrogen	240-250	240-250	8.21	21.7	0.551	
GWMW10	5/16/2013	217.54	Compressed Nitrogen	250-260	250-260	7.28	22.1	1.933	
GWMW11-S,I,D	4/16/2013	172.58	Bladder Pump	190-205	192.83	7.18	22.5	1.776	
GWMW15-S, I, D	4/19/2013	238.30	Bladder Pump	289.2-304.2	297	7.27	21.4	0.961	
MW-1	4/16/2013	188.16	Hydrasleeve	187-197	196.66	6.58	23.7	1.803	
MW-3	4/9/2013	185.00	Hydrasleeve	180-190	188	6.72	19.9	1.842	
MW-4 *	4/24/2013	181.75	Bailer	175-185	189	7.25	18.5	2.070	
MW-5	4/24/2013	187.80	Hydrasleeve	181.8-191.8	192	6.01	18.9	1.857	
MWSF-2 *	4/9/2013	184.50	Hydrasleeve	184.34-199.34	192	6.45	19.5	2.230	
MWSF-5	5/23/2013		Hydrasleeve	137.73-152.73	148	6.70	24.4	1.807	
MWSF-6	4/26/2013	124.85	Hydrasleeve	116.55-133.55	128	7.00	22.9	2.980	
MWSF-9 *	4/10/2013	186.33	Hydrasleeve	188.03-203.03	195.5	6.88	22.1	1.770	
MWSF-10	4/26/2013	191.75	Hydrasleeve	193.7-203.7	198	6.75	24.5	1.872	

* Critical Well Data Requested

5/31/2013 LJG

APPENDIX A.

TABLE A2. WATER-QUALITY DATA (APRIL - MAY 2013 SAMPLING)

CLC-JSP Griggs-Walnut Groundwater Well Sampling

Water Quality Laboratory (April - May 2013)

Sample Location	Sampling Date	Depth to Water (ft)	elevation (ft amsl)	Screen Interval (ft)	Water-Level Elevation (ft)	screen mid point (ft)	sample elevation	PCE (µg/L)	model layer	Field Parameters pH (SU)	Temp (°C)	Conduc-tivity (mS)	Comments
								2013					
CLC 18	4/15/2013	-		380-516.5		380-516.5		2.7	3	6.93	22.0	0.709	Process Water: Unable to measure static level, enclosed pump.
CLC 20	5/23/2013	143.56		380-395, 415-440, 450-525, 615-673		430		<1.0		6.75	27.6	1.594	Most of oil has been removed and now can be sampled.
CLC 27	4/1513	-		430-730		430-730		**14.0**	3	6.86	23.6	1.186	Process Water: Unable to measure static level, enclosed pump.
GWMW01-Port 1	5/8/2013	176.31	4035.7	210-220	3859.39	215	3,821	**11.0**	1	6.81	22.4	2.240	
GWMW01-Port 2	5/8/2013	176.31	4035.7	270-280	3859.39	275	3,761	<1.0	2	6.80	22.0	1.611	One Vial Collected for Port 2
GWMW01-Port 3	5/8/2013	176.31	4035.7	330-340	3859.39	335	3,701	3.2	3	10.64	23.3	1.635	
GWMW01-Port 4	5/8/2013	176.31	4035.7	420-430	3859.39	425	3,611	<1.0	3	8.65	22.8	0.790	
GWMW01-Port 5	5/8/2013	176.31	4035.7	460-470	3859.39	465	3,571	<1.0	3	8.49	23.6	0.569	
GWMW01-Port 6	5/8/2013	176.31	4035.7	515-525	3859.39	520	3,516	**14.0**	3	9.00	23.0	0.927	
GWMW01-Port 7	5/8/2013	176.31	4035.7	550-560	3859.39	555	3,481	3.6	4	8.93	22.5	0.668	
GWMW03-Port 1	5/10/2013	95.08	3975.2	140-150	3880.12	145	3,830	<1.0	1	8.19	24.2	2.340	
GWMW03-Port 2	5/10/2013	95.08	3975.2	225-235	3880.12	230	3,745	<1.0	2	9.90	23.9	1.477	
GWMW03-Port 3	5/10/2013	95.08	3975.2	270-280	3880.12	275	3,700	<1.0	3	11.40	24.9	1.886	
GWMW03-Port 4	5/10/2013	95.08	3975.2	320-330	3880.12	325	3,650	<1.0	3	11.36	23.4	2.77	Collect Port 4 on first purge.
GWMW03-Port 5	5/10/2013	95.08	3975.2	410-420	3880.12	415	3,560	<1.0	3	10.84	20.1	0.820	
GWMW03-Port 6	5/10/2013	95.08	3975.2	460-470	3880.12	465	3,510	<1.0	3	10.83	21.4	0.834	
GWMW08-Port 1	5/3/2013	164.25	4018.8	190-200	3854.55	195	3,824	na	1	-	-	-	Unable to sample: Leaking gas feed line to port tubing.
GWMW08-Port 2	5/3/2013	164.25	4018.8	255-265	3854.55	260	3,759	na	2	-	-	-	Unable to sample: Leaking gas feed line to port tubing.
GWMW08-Port 3	5/3/2013	164.25	4018.8	305-315	3854.55	310	3,709	<1.0	3	9.86	20.5	1.036	
GWMW08-Port 4	5/3/2013	164.25	4018.8	380-390	3854.55	385	3,634	<1.0	3	8.33	20.6	0.511	
GWMW08-Port 5	5/3/2013	164.25	4018.8	430-440	3854.55	435	3,584	<1.0	3	8.70	21.7	0.471	
GWMW08-Port 6	5/3/2013	164.25	4018.8	490-500	3854.55	495	3,524	<1.0	3	7.28	20.9	0.491	
GWMW08-Port 7	5/3/2013	164.25	4018.8	535-545	3854.55	540	3,479	<1.0	4	8.13	20.8	0.573	
GWMW09-Port 1	5/13/2013	196.00	4049.9	240-250	3853.90	245	3,805	<10.0	1	8.21	21.7	0.551	
GWMW09-Port 2	5/13/2013	196.00	4049.9	295-305	3853.90	300	3,750	**<9.8**	2	9.85	21.6	1.701	
GWMW09-Port 3	5/13/2013	196.00	4049.9	355-365	3853.90	360	3,690	<4.9	3	10.95	21.9	2.360	
GWMW09-Port 4	5/13/2013	196.00	4049.9	410-420	3853.90	415	3,635	0.7	3	9.36	21.5	1.788	
GWMW09-Port 5	5/13/2013	196.00	4049.9	480-490	3853.90	485	3,565	<4.9	3	9.87	21.4	1.710	
GWMW09-Port 6	5/13/2013	196.00	4049.9	550-560	3853.90	555	3,495	<4.9	4	8.62	21.1	1.241	
GWMW09-Port 7	5/13/2013	196.00	4049.9	630-640	3853.90	635	3,415	<4.9	4	9.57	21.3	0.507	
GWMW10-Port 1	5/16/2013	217.54	4063.4	250-260	3845.86	255	3,808	<1.0	1	7.28	22.1	1.933	
GWMW10-Port 2	5/16/2013	217.54	4063.4	320-330	3845.86	325	3,738	**7.1**	2	10.85	22.1	1.450	
GWMW10-Port 3	5/16/2013	217.54	4063.4	370-380	3845.86	375	3,688	**42.0**	3	7.89	22.1	1.682	
GWMW10-Port 4	5/16/2013	217.54	4063.4	440-450	3845.86	445	3,618	3.7	3	7.96	22.4	1.363	
GWMW10-Port 5	5/16/2013	217.54	4063.4	505-515	3845.86	510	3,553	<1.0	3	8.28	23.1	1.389	
GWMW10-Port 6	5/16/2013	217.54	4063.4	560-570	3845.86	565	3,498	<1.0	4	10.39	22.7	1.285	
GWMW10-Port 7	5/16/2013	217.54	4063.4	620-630	3845.86	625	3,438	<1.0	4	10.23	22.8	0.580	
GWMW11-S *	4/16/2013	172.58	4021.46	190-205	3848.88	192	3,829	<1.0	1	7.18	22.5	1.776	
GWMW11-I *	4/18/2013	185.90	4021.42	299.1-314.1	3835.52	308	3,713	<1.0	3	7.17	20.7	1.352	
GWMW11-D *	4/17/2013	186.54	4021.46	525-540	3834.92	533	3,488	<1.0	4	7.45	20.8	0.573	
GWMW15-S	4/19/2013	238.30	4079.84	289.2-304.2	3841.54	297	3,783	<1.0	2	7.27	21.4	0.961	
GWMW15-I	5/1/2013	239.70	4079.89	460-475	3840.19	468	3,612	<1.0	3	7.08	23.7	1.590	
GWMW15-D	4/29/2013	239.70	4079.85	5889.2-595.6	3840.15	588	3,492	<1.0	4	7.48	23.3	0.986	
MW-1	4/16/2013	188.16	4035.75	187-197	3847.59	197	3,839	<5.0	1	6.58	23.7	1.803	
MW-3	4/9/2013	185.00	4032.13	180-190	3847.13	188	3,844	2.4	1	6.72	19.9	1.842	
MW-4 *	4/24/2013	181.75	4029.08	175-185	3847.33	189	3,840	4.2	1	7.25	18.5	2.070	
MW-5	4/24/2013	187.80	4033.79	181.8-191.8	3845.99	192	3,842	<1.0	1	6.01	18.9	1.857	
MWSF-2 *	4/9/2013	184.50	4033.35	184.34-199.34	3848.85	192	3,841	**7.4**	1	6.45	19.5	2.230	
MWSF-5	5/23/2013		3992.93	137.73-152.73		148	3,845		1	6.70	24.4	1.807	
MWSF-6	4/26/2013	124.85	3976.12	116.55-133.55	3851.27	128	3,848	<1.0	1	7.00	22.9	2.980	
MWSF-9 *	4/10/2013	186.33	4030.08	188.03-203.03	3843.75	196	3,834	<1.0	1	6.88	22.1	1.770	
MWSF-10	4/26/2013	191.75	4036.53	193.7-203.7	3844.78	198	3,839	**10.0**	1	6.75	24.5	1.872	

* Critical Well Data Requested
bold are greater than 5.0

5/31/2013 LJG

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Appendix B.

General-chemistry data from selected wells in the Griggs and Walnut plume area

APPENDIX B.

General-chemistry data from selected wells in the Griggs and Walnut plume area

	site	Well 27	Well 27	Well 18	Well 18	GWMW01, Well Port No. 1	GWMW01, Well Port No. 1	GWMW01, Well Port No. 2	GWMW01, Well Port No. 3	GWMW01, Well Port No. 4	GWMW01, Well Port No. 5	GWMW01, Well Port No. 6	GWMW01, Well Port No. 6	GWMW01, Well Port No. 7	GWMW09, Well Port No. 1	GWMW09, Well Port No. 2
	date	**1980**	**2010**	**1980**	**2010**	**2004**	**2005**	**2004**	**2004**	**2004**	**2004**	**2004**	**2005**	**2004**	**2004**	**2004**
	units															
Metals																
Al	mg/L					0.2		0.2	0.619	0.2	0.2	0.2		0.2	0.2	0.558
As(+5)	mg/L	0.005	0.0011	0.004	0.0017	0.0078		0.076	0.104	0.0321	0.0293	0.0442		0.0158	0.0345	0.0399
Ba	mg/L	0.25	0.068	0.15	0.051	0.0429		0.0411	0.0063	0.0402	0.0329	0.0483		0.0546	0.0748	0.0507
Cd	mg/L	0.005		0.003		0.005		0.005	0.005	0.005	0.005	0.005		0.005	0.005	0.005
Co	mg/L					0.05		0.05	0.05	0.05	0.05	0.05		0.05	0.05	0.05
Cu	mg/L					0.025		0.025	0.025	0.025	0.025	1.18		0.005	0.0206	0.0059
Fe+3	mg/L	0.28	0.2	0.125	0.12	0.57		1.51	0.0984	0.099	0.49	1.18		1.55	3.87	0.57
Pb	mg/L	0.005		0.004		0.01		0.0044	0.01	0.01	0.0096	0.0074		0.01	0.0251	0.004
Mn	mg/L	0.07		0.025		0.0632		0.0252	0.015	0.015	0.0032	0.0535		0.104	0.0223	0.0119
Mo	mg/L															
Sr	mg/L															
Zn	mg/L															
General Chemistry																
HCO3	mg/L	169.1	170	159.3	280		306.22						154.94			
CO3	mg/L	3.8		0			3						12			
Cl	mg/L	79.8	130	35.5	220		248						68			
F	mg/L	0.64	0.46	0.82	0.46											
NO3	mg/L	0.49	1.6	0.02	1.6		6.47						0.386			
SO4	mg/L	131.3	180	69.6	360		369						81			
Ca	mg/L	63.8	95	37.6	180	169	181	49.4	12.1	10.7	19.6	49.1	24.7	85.9	53.2	28.9
Mg	mg/L	22.3	0.07	9.7	41		43						7.09			
K	mg/L	6.63	9.1	6.05	10	18.3		63.3	85.4	82.3	42.3	55.5		28.2	83.3	147
Na	mg/L	62.1	82	48.3	170											
SiO2	mg/L		13		16											
pH		8.31	7.49													
specific cond	(µS/cm)															
TEMP			70.3													
TDS (calc sum ions)		549	689	367	1279		1157						348			

APPENDIX B.

General-chemistry data from selected wells in the Griggs and Walnut plume area

	site	GWMW09, Well Port No. 3	GWMW09, Well Port No. 4	GWMW09, Well Port No. 4	GWMW09, Well Port No. 5	GWMW09, Well Port No. 6	GWMW09, Well Port No. 7	GWMW10, Well Port No. 1	GWMW10, Well Port No. 2	GWMW10, Well Port No. 2	GWMW10, Well Port No. 3	GWMW10, Well Port No. 4	GWMW10, Well Port No. 5	GWMW10, Well Port No. 6	GWMW10, Well Port No. 7
	date	2004	2004	2005	2004	2004	2004	2004	2004	2005	2004	2004	2004	2004	2004
	units														
Metals															
Al	mg/L	0.523	0.2		0.2	0.2	0.33	0.45	0.2		0.597	0.2	0.457	0.2	0.201
As(+5)	mg/L	0.0366	0.0097		0.015	0.0441	0.013	0.015	0.0493		0.0117	0.0512	0.0268	0.062	0.0399
Ba	mg/L	0.0556	0.0914		0.0831	0.0499	0.0284	0.0553	0.0505		0.0834	0.0542	0.0485	0.0385	0.0112
Cd	mg/L	0.005	0.005		0.005	0.005	0.005	0.005	0.005		0.005	0.005	0.005	0.005	0.005
Co	mg/L	0.05	0.05		0.05	0.05	0.05	0.001	0.05		0.05	0.05	0.05	0.05	0.05
Cu	mg/L	0.0365	0.025		0.025	0.025	0.025	0.0237	0.0021		0.025	0.0013	0.0036	0.0018	0.0054
Fe+3	mg/L	0.955	1.64		0.12	0.199	0.213	6.01	0.651		6.48	0.1	0.36	0.1	0.146
Pb	mg/L	0.0097	0.01		0.01	0.01	0.0048	0.01	0.01		0.01	0.01	0.01	0.01	0.0049
Mn	mg/L	0.0269	0.0311		0.0332	0.0039	0.0094	0.0627	0.0204		0.0642	0.0185	0.0022		0.00093
Mo	mg/L														
Sr	mg/L														
Zn	mg/L														
General Chemistry															
HCO3	mg/L			51.24						61					
CO3	mg/L			10.8						6					
Cl	mg/L			243						217					
F	mg/L														
NO3	mg/L			7.4						5.68					
SO4	mg/L			364						302					
Ca	mg/L	22.4	119		72.5	25.1	7.18	175	0.005	51.2	156	108	23.9	38.2	5.14
Mg	mg/L			19.9						18.7					
K	mg/L	224	65.9		57.3	36.3	32.4	23.9	84.9		38.7	76.6	96.5	65.8	22.1
Na	mg/L														
SiO2	mg/L														
pH															
specific cond	(µS/cm)														
TEMP															
TDS (calc sum ions)				696						662					

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Appendix C.

Selected hydrographs from wells in the Griggs and Walnut plume area

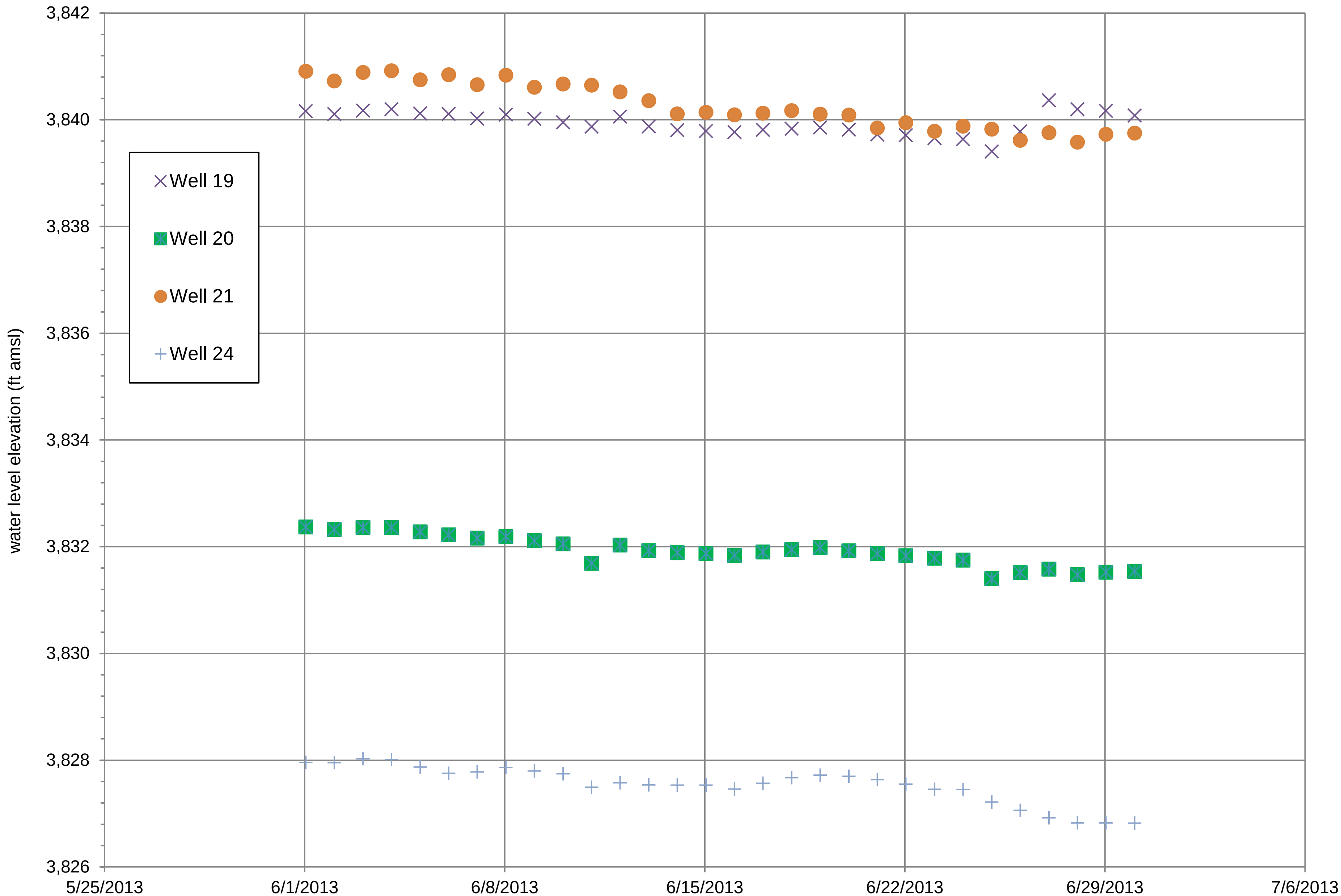

Figure C1. Graph of water-level elevations City of Las Cruces Wells 19, 20, 21, and 24, Griggs and Walnut site, New Mexico.

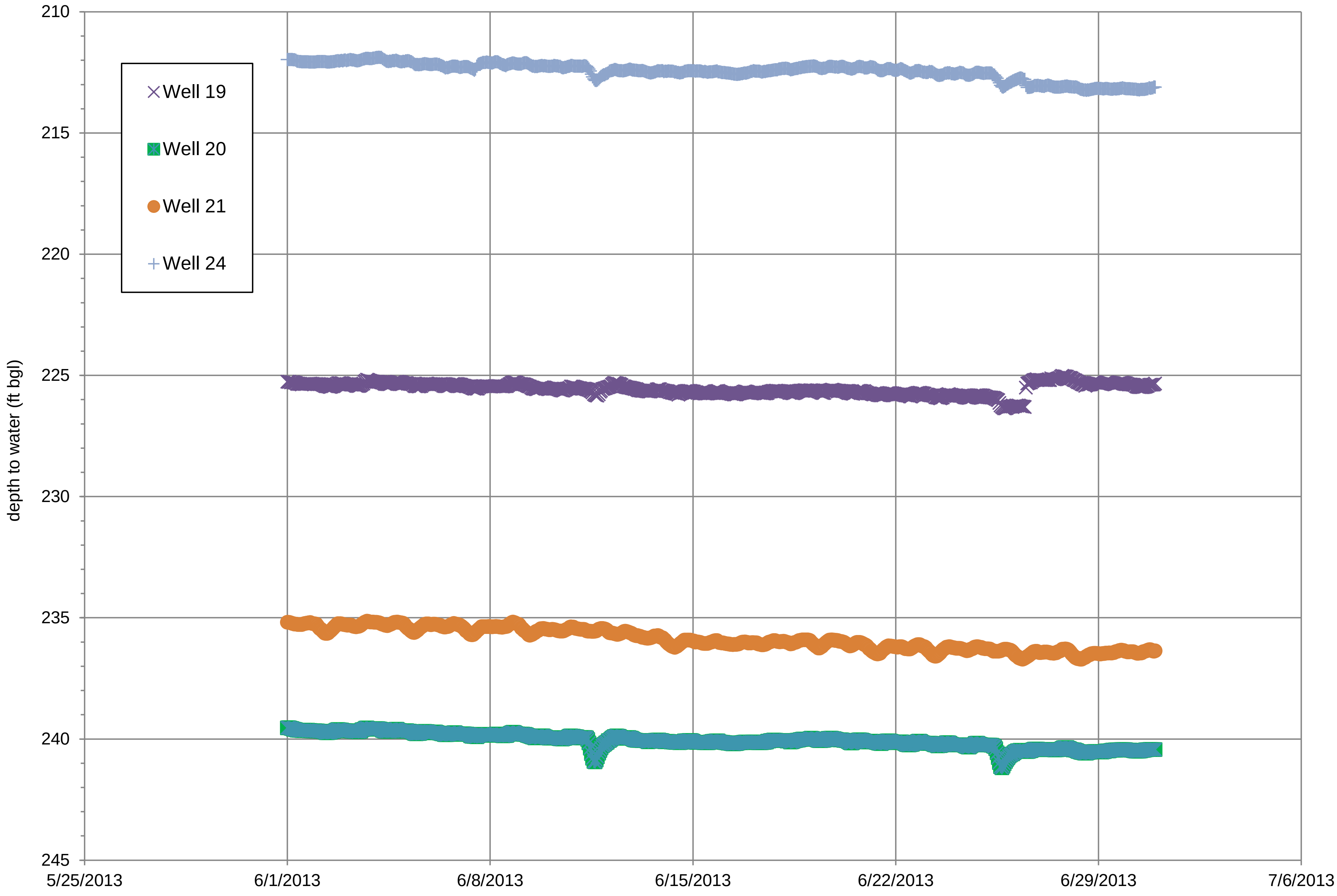

Figure C2. Graph of depth to water City of Las Cruces Wells 19, 20, 21, and 24, Griggs and Walnut site, New Mexico.

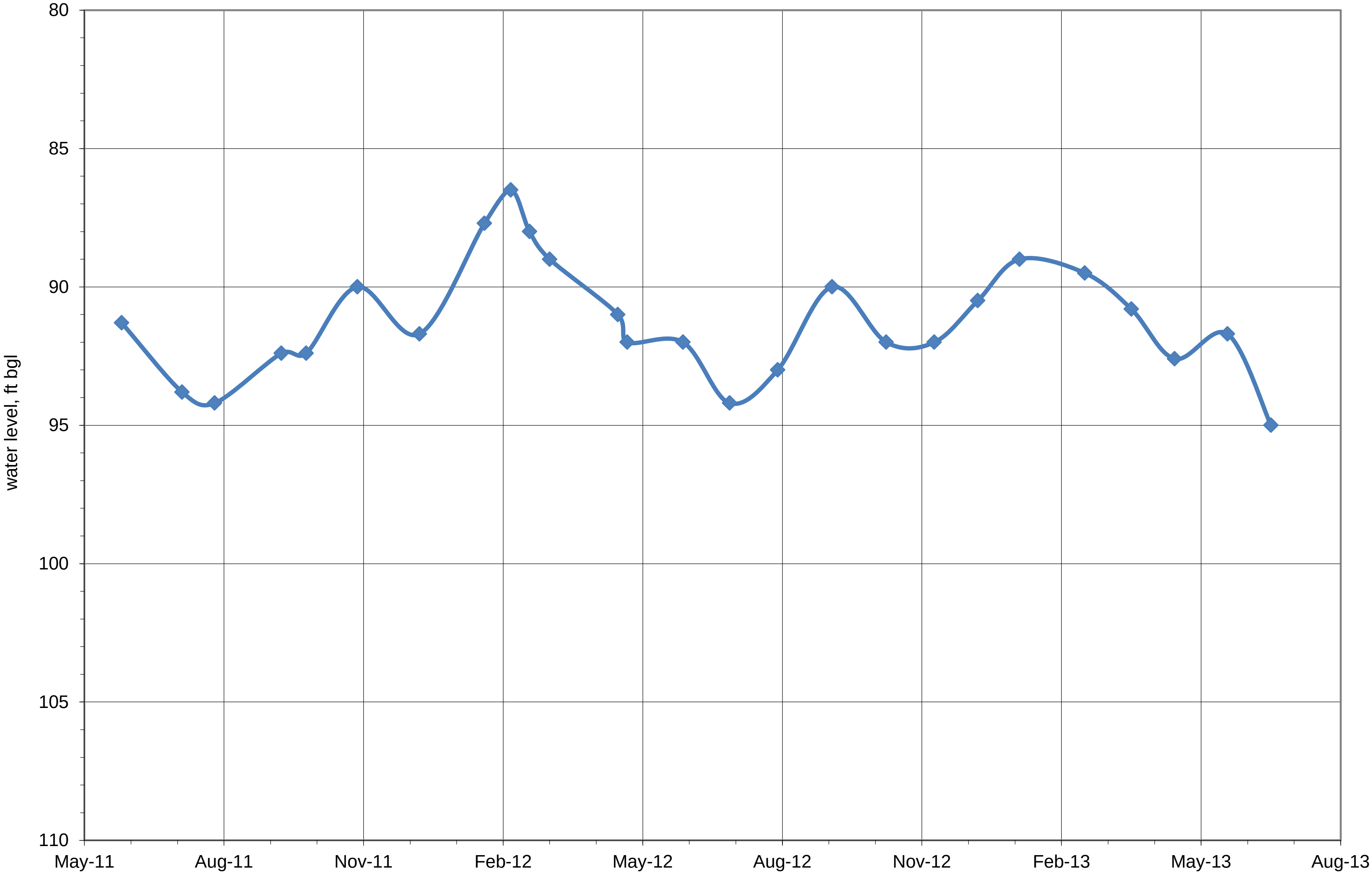

Figure C3. Graph of water-level data collected by the City of Las Cruces for Well 10, Griggs and Walnut site, New Mexico.

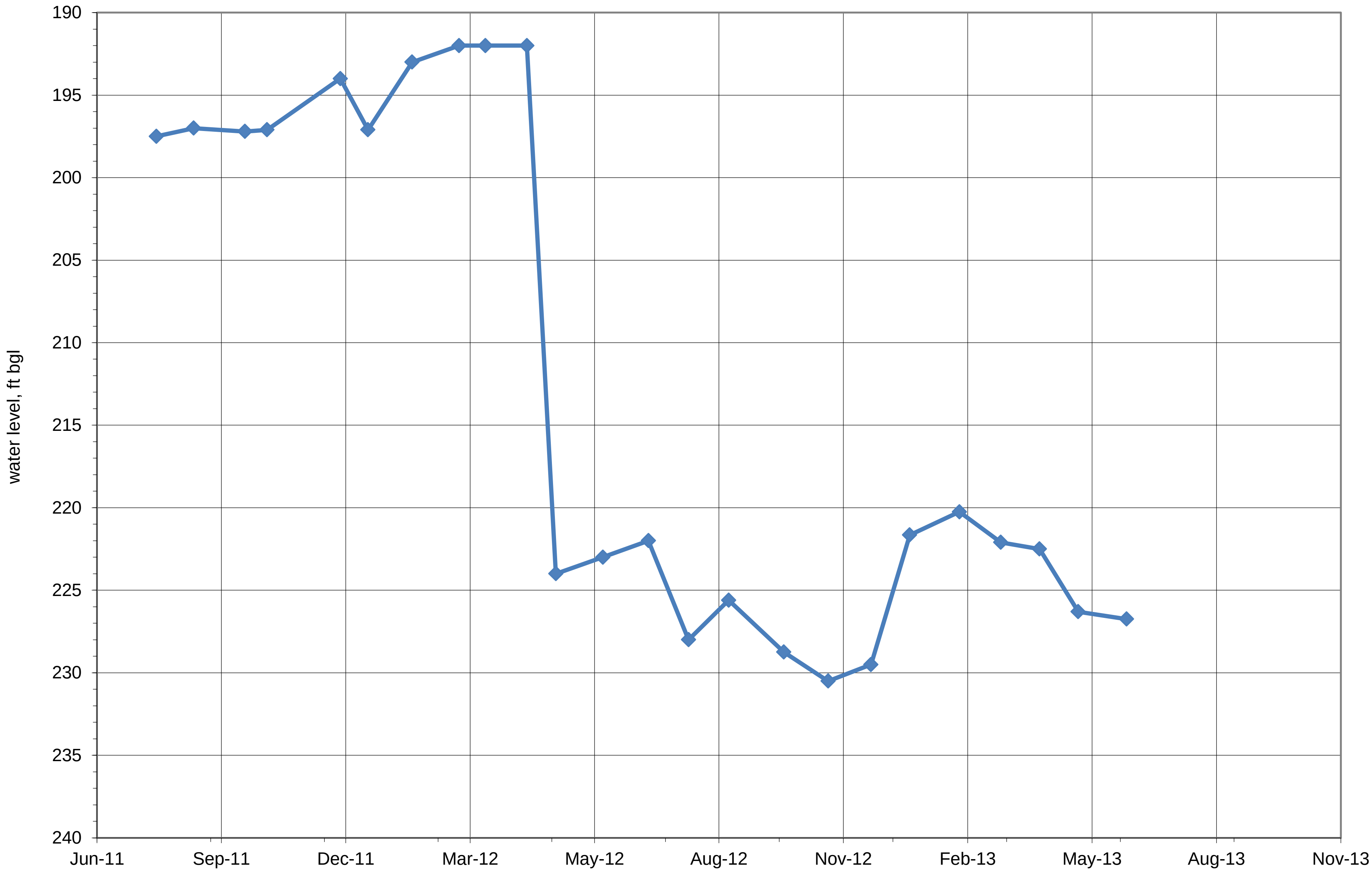

Figure C4. Graph of water-level data collected by the City of Las Cruces for Well 18, Griggs and Walnut site, New Mexico.

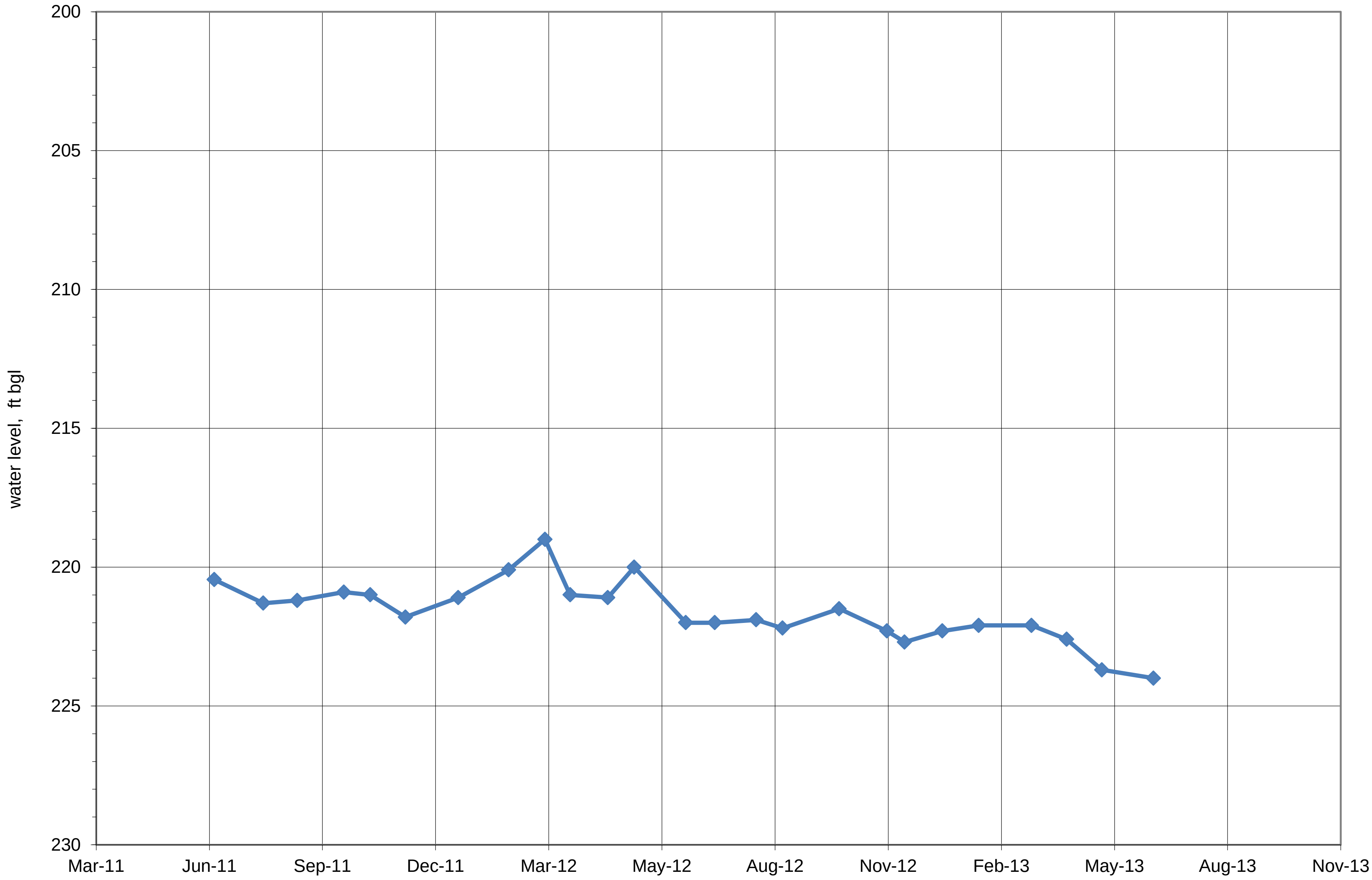

Figure C5. Graph of water-level data collected by the City of Las Cruces for Well 19, Griggs and Walnut site, New Mexico.

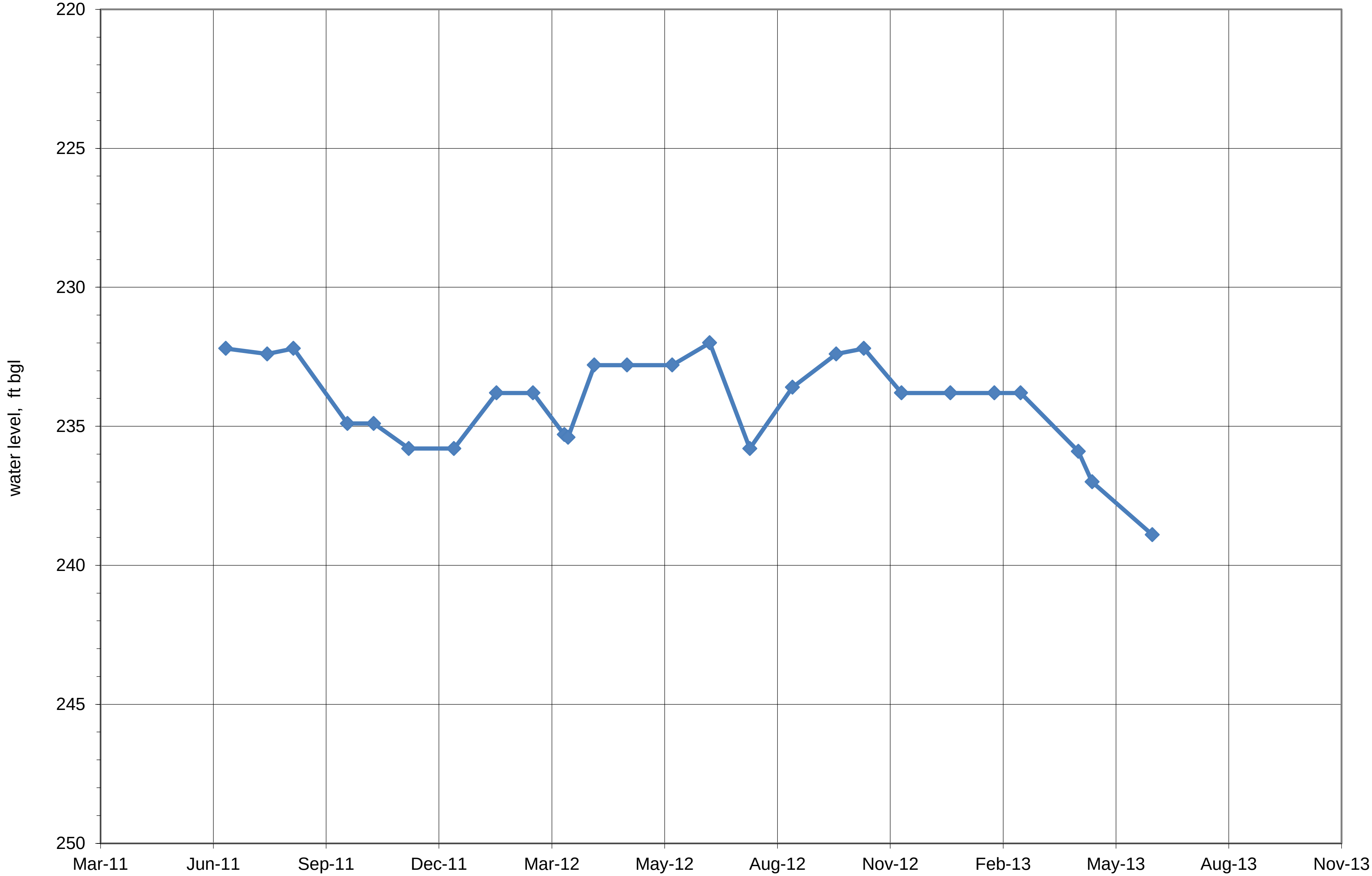

Figure C6. Graph of water-level data collected by the City of Las Cruces for Well 20, Griggs and Walnut site, New Mexico.

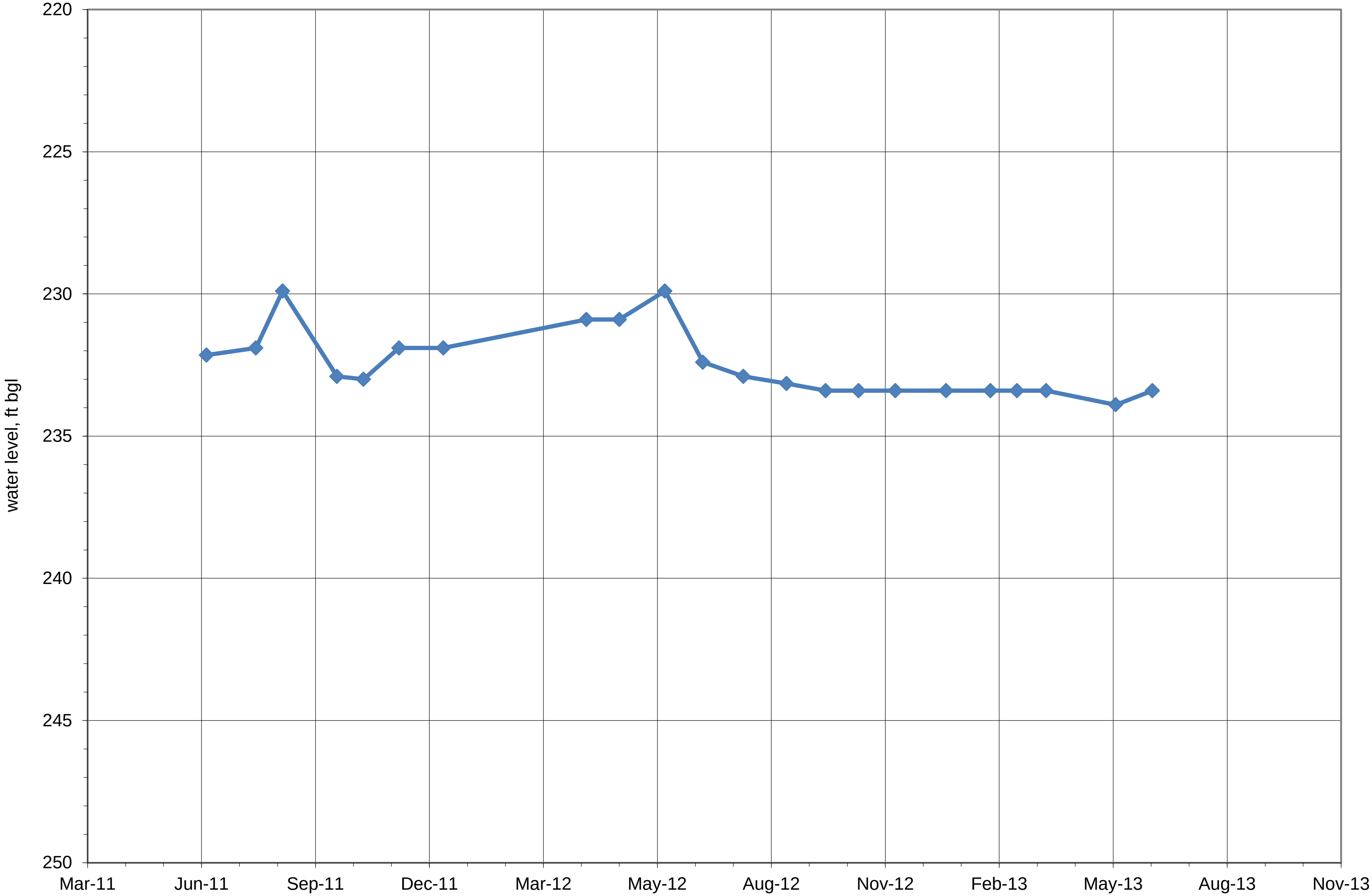

Figure C7. Graph of water-level data collected by the City of Las Cruces for Well 21, Griggs and Walnut site, New Mexico.

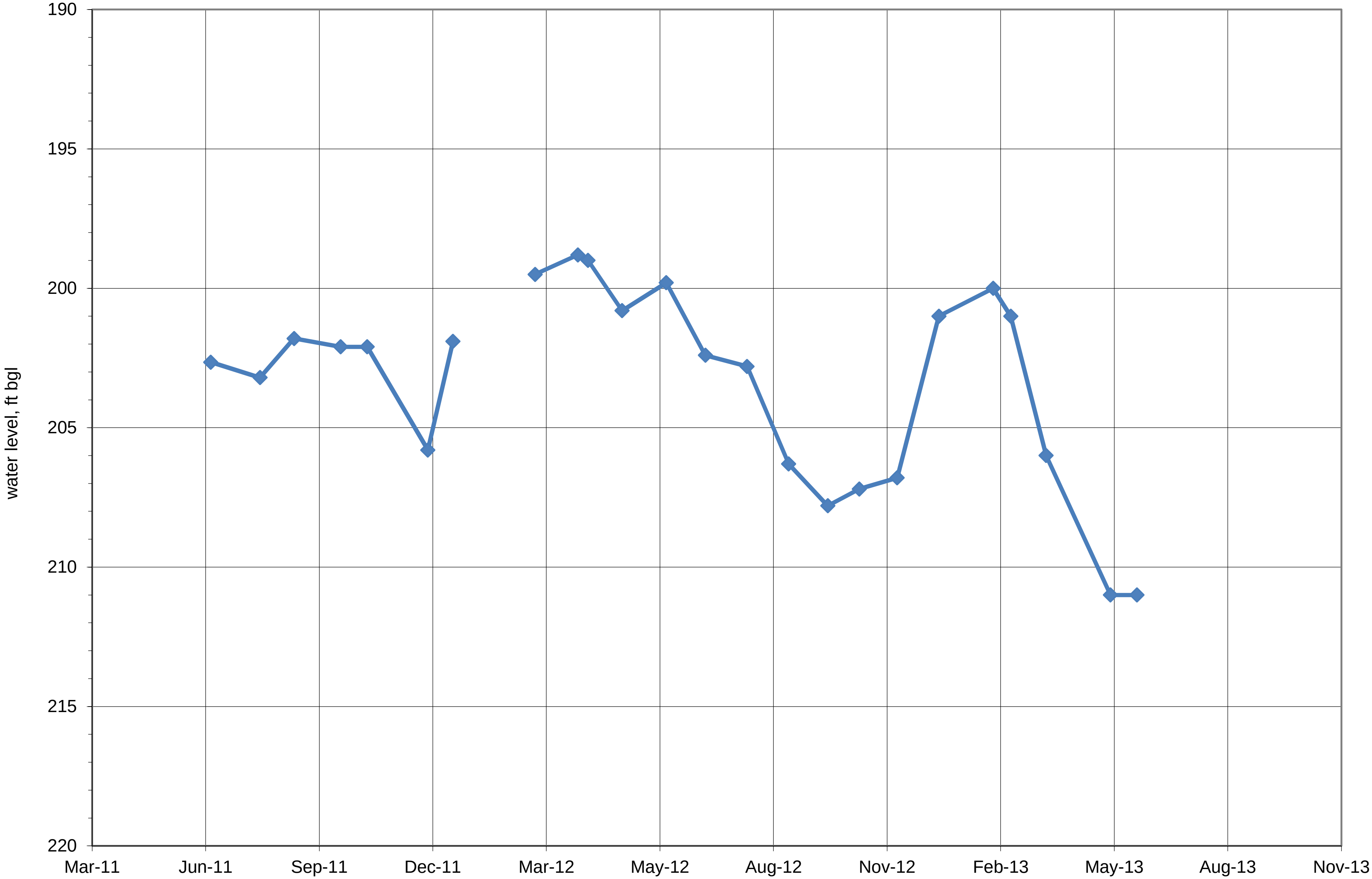

Figure C8. Graph of water-level data collected by the City of Las Cruces for Well 24, Griggs and Walnut site, New Mexico.

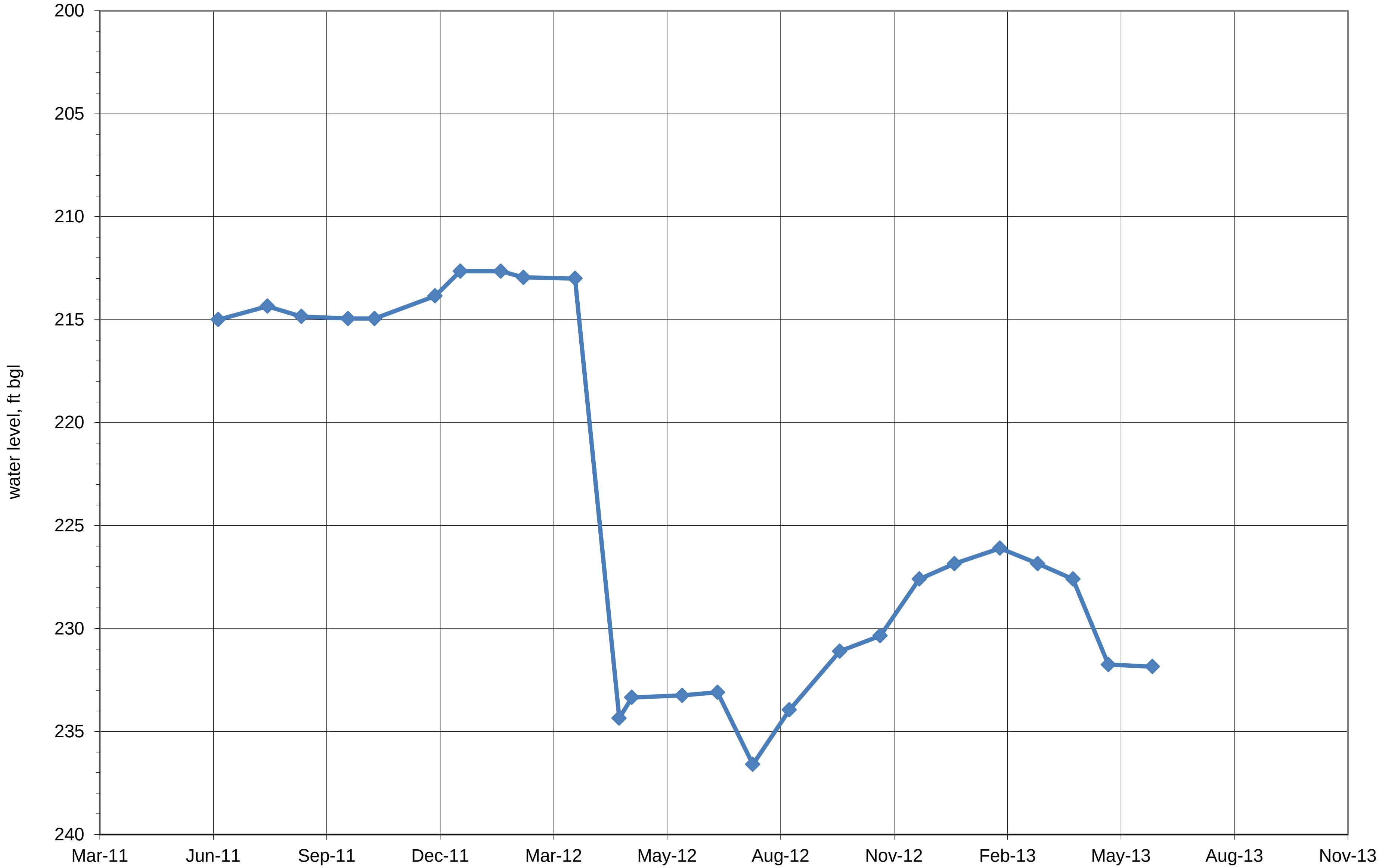

Figure C9. Graph of water-level data collected by the City of Las Cruces for Well 27, Griggs and Walnut site, New Mexico.

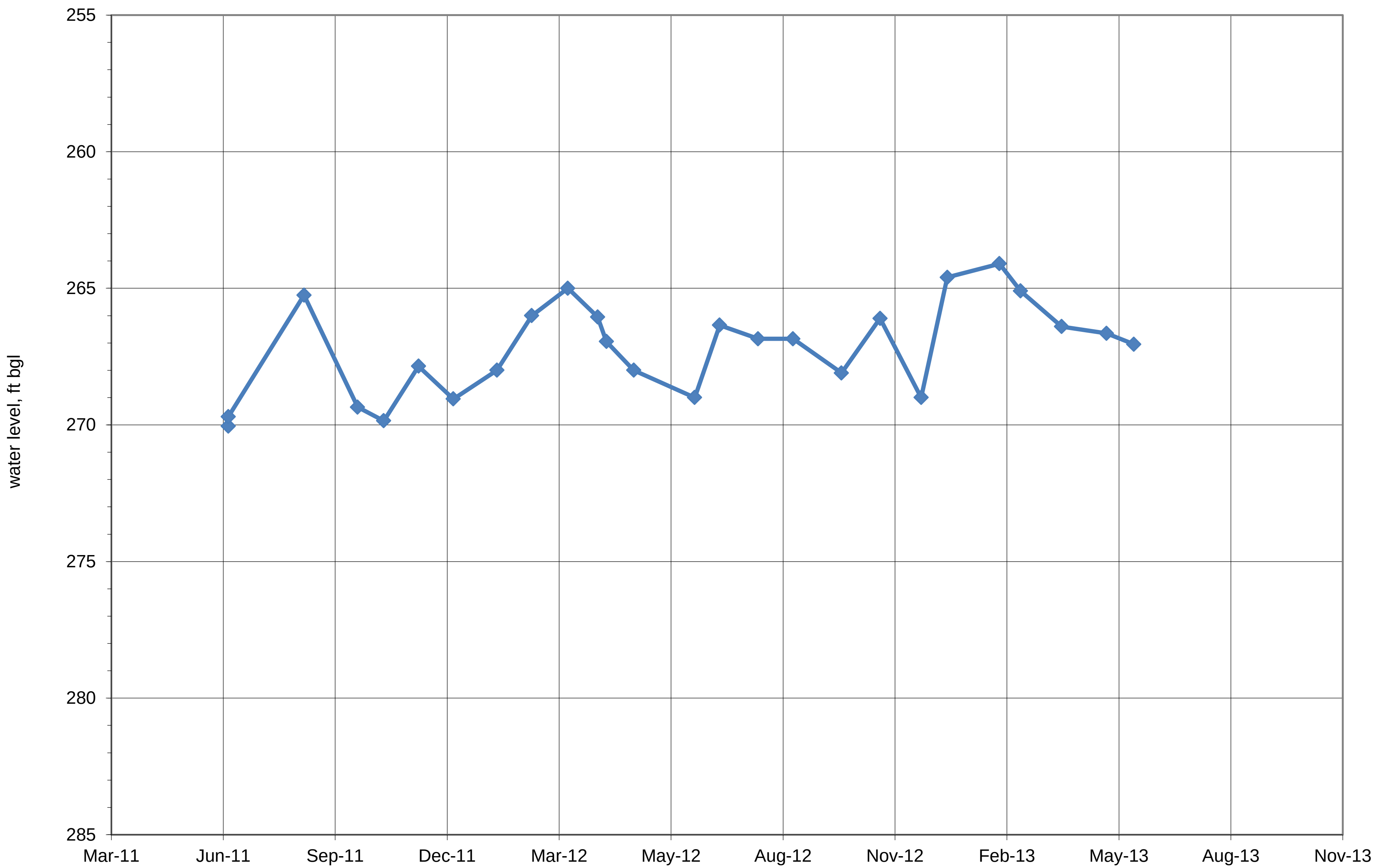

Figure C10. Graph of water-level data collected by the City of Las Cruces for Well 54, Griggs and Walnut site, New Mexico.

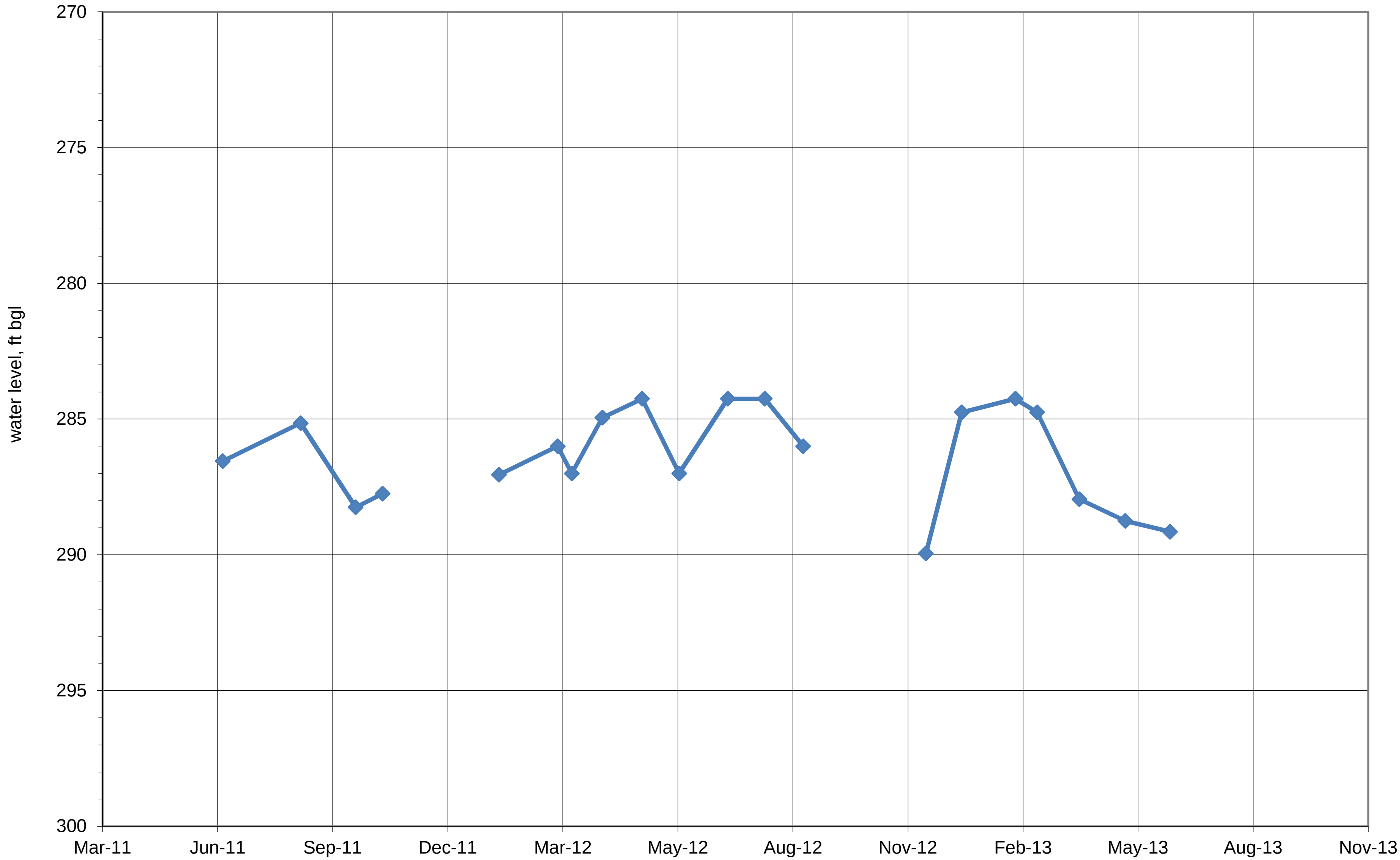

Figure C11. Graph of water-level data collected by the City of Las Cruces for Well 57, Griggs and Walnut site, New Mexico.

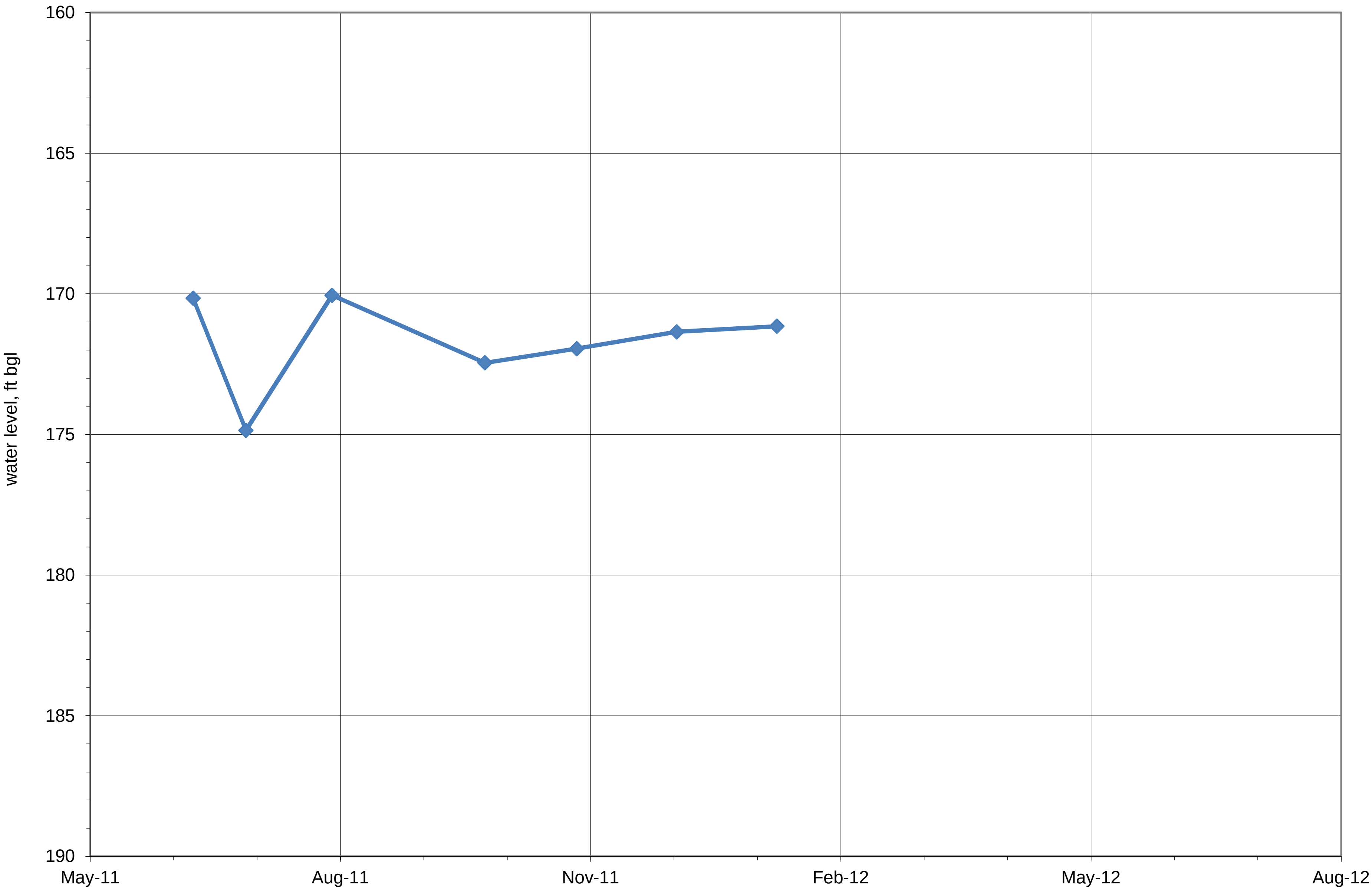

Figure C12. Graph of water-level data collected by the City of Las Cruces for Paz Park Well, Griggs and Walnut site, New Mexico.

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Appendix D.

Technical memorandum describing radial flow model analysis for Well 18

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TECHNICAL MEMORANDUM

To: Steve Finch, Principal Hydrogeologist-Geochemist, JSAI

From: Jake Baggerman, Staff Hydrogeologist, JSAI

Date: July 17, 2013

Subject: Las Cruces Well 18 radial flow model

BACKGROUND

An analysis of the October 27, 2010 step-drawdown pumping test carried out on Las Cruces Well 18 was performed through the use of a finite-difference radial-flow numerical model based on the techniques developed by Rushton and Redshaw (1979), further described in Rathod and Rushton (1991). The purpose of utilizing the radial-flow model was to examine the contribution to pumping at varied rates by different modeled layers.

MODEL CONSTRUCTION AND CALIBRATION

The layered aquifer system is modeled as an upper layer and a lower layer and allows for variable transfer between layers. The lower layer contains the screened zone from 315 to 516.5 ft below ground level (bgl) and the upper layer represents the hydrologic zone from 0 to 315 ft bgl. The model parameters are outlined in Table 1 below.

Calibration was performed using data from the October 27, 2010 step-drawdown pumping test of Well 18 and results can be seen on Figure 1 below. The calibrated transmissivity value for the screened interval coincides well with the apparent transmissivity of the area which was calculated from pumping test data to be 3,390 ft^2/day (JSAI, 2011).

Table 1. Model parameters

parameter	unit	value
upper layer		
thickness	ft	315
radial hydraulic conductivity	ft/day	3.0
transmissivity	ft^2/day	945.0
storage coefficient	-	0.00008
anisotropy	-	0.1
lower layer		
thickness	ft	201.5
radial hydraulic conductivity	ft/day	15.0
transmissivity	ft^2/day	3,022.5
storage coefficient	-	0.00008
anisotropy	-	0.1
gravel-packed annulus		
radial hydraulic conductivity	ft/day	1.9
vertical permeability	ft/day	1.0
storage coefficient	-	0.002

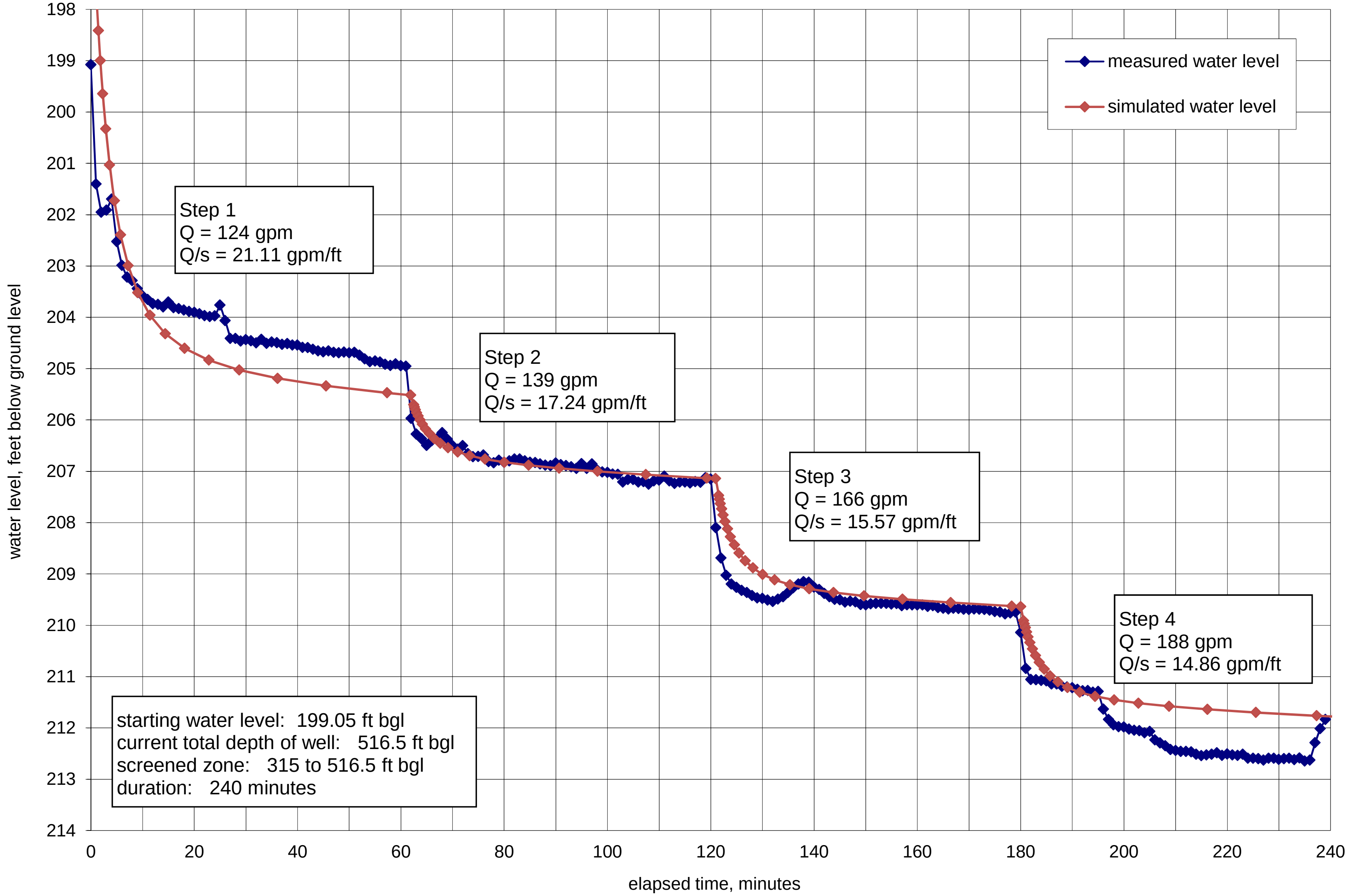

Figure 1. Graph showing results of step-drawdown pumping test and model-simulated drawdown for City of Las Cruces Well No. 18 after back plugging prodedures.

RESULTS

The calibrated Well 18 model was used to examine contribution to pumping by each layer at 150 gpm, 200 gpm, and 250 gpm. Results of this analysis are presented on table 2 below. In each scenario the contribution to pumping from the upper layer was roughly 15% with contribution from the lower layer being around 85%. Contributions from the upper layer occur through the gravel-packed annulus.

Table 2. Flow from each layer in the Well 18 radial-flow model

	gpm	amount pumped (ft^3/day)	contribution to pumping (percent)
150 gpm			
total flow	150	829,618	
upper layer	25	128,036	15.4
lower layer	125	701,582	84.6%
200 gpm			
total flow	200	1,105,913	
upper layer	33	168,241	15.2
lower layer	167	937,671	84.8
250 gpm			
total flow	250	1,382,083	
upper layer	40	207,174	15.0
lower layer	210	1,174,909	85.0

gpm - gallons per minute

WORK CITED

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Rushton, K.R., and Redshaw, S.C., 1979, Seepage and groundwater flow: numerical analysis by analog and digital methods: John Wiley & Sons, Ltd., New York.

Appendix B

CLC Monitor Well Location Report

City of Las Cruces

Griggs - Walnut Superfund Monitoring Wells

Location of monitoring wells

Eric Chavez, Fernando Ortiz, & Lorenzo Hernandez

August 22, 2013

Does not include City of Las Cruces Wells

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W E
S

GRIGGS-WALNUT GROUND WATER PLUME SITE
Groundwater Sampling Well Locations

Does not include City of Las Cruces Wells

450 225 0 450 Feet

Well ID: GWMW-01

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483310.147 Y: 479017.888 Elevation: 4034.679

Comments:

7 Sampling tubes 24" diameter manhole

20" depth from sampling tube to existing grade

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	GWMW-03

Groundwater Sampling Well Site Map

	
Figure 1: Top View	Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1480643.535 Y: 479520.191 Elevation: 3974.09

Comments:

26" Diameter lid 6 sampling tubes

5" cover from sampling tube to existing grade.

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	GWMW-08

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483350.784 Y: 480044.862 Elevation: 4017.805

Comments:

26" Diameter lid 7 sampling tubes

7" From sampling tube to top of steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID: GWMW-09

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1485067.177 Y: 480413.319 Elevation: 4049.16

Comments:

26" Diameter lid 7 sampling tubes

3" from sampling tube to top of casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	GWMW-10

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1484919.934 Y: 479228.801 Elevation: 1484919.934

Comments:

26" Diameter lid 7 sampling tubes

3" from sampling tube to top of casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	GWMW-11 I -11S -11D

Groundwater Sampling Well Site Map

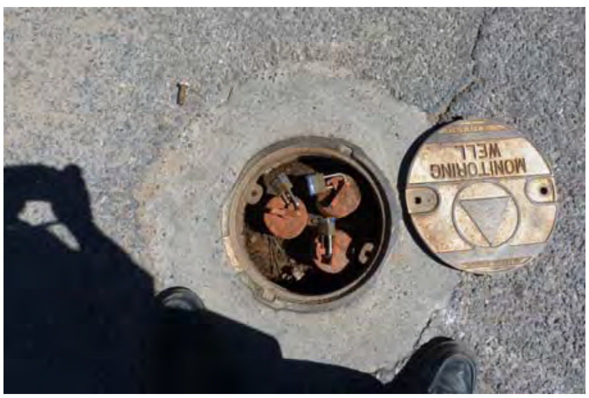

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483174.223	Y: 477985.287	Elevation: 4021.221	GWMW-11 I
X: 1483174.455	Y: 477985.026	Elevation: 4021.271	GWMW-11 S
X: 1483174.634	Y: 477985.338	Elevation: 4021.27	GWMW-11 D

Comments:

2" from sampling tube to top of casing   12" Steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	GWMW-15 I-S-D

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1486667.912	Y: 480905.773	Elevation: 4079.546	GWMW-15 I
X: 1486668.268	Y: 480905.551	Elevation: 4079.506	GWMW-15 S
X: 1486667.87	Y: 480905.418	Elevation: 4079.552	GWMW-15 D

Comments:

2" from sampling tube to top of casing 12" Steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-1

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483492.17 Y: 478754.722 Elevation: 4035.569

Comments:

12" Steel casing

7-3/4" depth from sampling tube to pavement elevation

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-2

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483483.825 Y: 478838.725 Elevation: 4035.87

Comments:

10" PVC casing 10" depth from sampling tube to top of casing

Sampling pipe is bent

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-3

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483203.198 Y: 478919.021 Elevation: 4033.066

Comments:

Flush with existing grade

7" steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

	Well ID: MW-4

Groundwater Sampling Well Site Map

	
Figure 1: Top View	Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483079.246 Y: 478681.285 Elevation: 4030.004

Comments:

6" depth from sampling tube to existing grade.

8" steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-5

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483553.479 Y: 478579.577 Elevation: 4034.671

Comments:

20" depth from sampling tube to existing grade

2.5" Steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-6

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483909.108 Y: 478704.465 Elevation: 4043.284

Comments:

Concrete collar in place. 2.5" PVC casing

4.5" depth from sampling tube to top of casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID: MW-SF1

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483447.604 Y: 478963.875 Elevation: 4035.574

Comments:

15" depth from sampling tube to top casing

6" steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID: MW-SF2

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1483252.505 Y: 478837.65 Elevation: 4034.34

Comments:

4" depth from sampling tube to existing grade.

No lid

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

	Well ID: MW-SF3

Groundwater Sampling Well Site Map

Figure 1: Top View	Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1482893.821 Y: 478741.255 Elevation 4025.941

Comments:

5 Gallon bucket being used as casing

4.5" cover from sampling tube to existing grade.

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-SF4

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1482727.736 Y: 478933.052 Elevation: 4023.961

Comments:

No steel casing found

Well was covered under 12.5’ of base course. Did notice material going in to the well.

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-SF5

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1481959.628 Y: 479614.773 Elevation: 3994.016

Comments:

7" Cover from sampling tube to existing grade.

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-SF6

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1480848.053 Y: 479654.254 Elevation: 3976.949

Comments:

6" Cover from sampling tube to existing grade.

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-SF9

Groundwater Sampling Well Site Map

Figure 1: Top View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1484636.285 Y: 478481.809 Elevation: 4030.94

Comments:

3.5" depth from sampling tube to existing grade

12" Steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Well ID:	MW-SF10

Groundwater Sampling Well Site Map

Figure 1: Top View

Figure 2: Ground View

Coordinates in Horizontal NAD83 and Vertical NAD29:

X: 1484356.814 Y: 480156.886 Elevation: 4037.125

Comments:

12" Steel casing

3.5" from sampling tube to top of steel casing

Field work and documentation done by:

Eric Chavez, Fernando Ortiz, and Lorenzo Hernandez

Appendix C

Laboratory Reports

This appendix is provided as electronic files on a CD in the hard copy report and in a separate folder on this report CD.